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Resistance of Flexible Membrane Liners to Chemicals and Wastes

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RESISTANCE OF FLEXIBLE MEMBRANE LINERS TO CHEMICALS AND WASTES

by

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16. ABSTRACT

The function of flexible membrane liners (FML's) is to contain waste and leachates. FML's based on synthetic polymeric materials may be degraded and permeated by the fluids that must be contained. Qualitative and quantitative information on the chemical resistance of FML's materials has been collected from vendors and technical publications and compiled into a data base. Criteria for assessing the information were developed and, in the basis of these criteria. FML ratings were developed for each chemical-material pair for which there were data. The ratings are not appropriate, however, as a basis for selection or rejection of a FML since they do not take into account the intended application, nor have they been substantiated in field experience.

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FOREWORD

Today's rapidly developing and changing technologies and industrial products and practices frequently carry with them the increased generation of solid and hazardous wastes. These materials, if improperly dealt with, can threaten both public health and the environment. Abandonded waste sites and accidental releases of toxic and hazardous substances to the environment also have important environmental and public health implications. The Hazardous Waste Engineering Research Laboratory assists in providing an authoritative and defensible engineering basis for assessing and solving these problems. Its products support the policies, programs and regulations of the Environmental Protection Agency, the permitting and other responsibilities of State and local governments and the needs of both large and small businesses in handling their wastes responsibily and economically.

This report describes the results of a project to compile all known data on the resistance of polymeric flexible membrane liners (FMLs) to waste chemicals that may be found in hazardous waste landfills and surface impoundments. This information should be of assistance to those involved in selecting liner materials for such disposal faciiilities and to those in the regulatory community who must evaluate the appropriateness of the selection.

David G. Stephan, Director
Hazardous Waste Engineering Research Laboratory

ABSTRACT

The function of flexible membrane liners (FMLs) is to contain wastes and leachates. FMLs made of synthetic polymeric materials may be subject to degradation and permeation by the fluids that must be contained. Qualitative and quantitative information on the chemical resistance of FML materials has been collected from vendors and technical publications. This information has been compiled into a computer data base comprising about 3,000 data fields on 23 liner materials and over 500 chemicals. A printout of this information is included as an appendix.

Criteria for assessing this information on a common basis were developed, with separate quidelines established for the olefinic and non-olefinic liner materials. On the basis of these criteria, normalized ratings of chemical resistance were developed for each chemical/material pair for which there were data. In all, 1300 ratings were developed and have been summarized in a chemical resistance matrix. These ratings are intended to provide guidance to those involved in the utilization of FMLs. The ratings, however, are not appropriate as a basis for selection or rejection of an FML since they do not take into account the intended FML application. Furthermore, the pertinence of the criteria on which the ratings are based has not been substantiated by field experience.

ABSTRACT

The function of flexible membrane liners (FMLs) is to contain wastes and leachates. FMLs made of synthetic polymeric materials may be subject to degradation and permeation by the fluids that must be contained. Qualitative and quantitative information on the chemical resistance of FML materials has been collected from vendors and technical publications. This information has been compiled into a computer data base comprising about 3,000 data fields on 23 liner materials and over 500 chemicals. A printout of this information is included as an appendix.

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ABBREVIATIONS

AC - asphalt concrete
ASPH - asphalt
CASNO - Chemical Abstracts Registery Number
cm - centimeter
CO - polyepichlorohydrin
COPOL - copolymer
CPE - chlorinated polyethylene
CR - polychloroprene
CSPE - chlorosulphonated polyethylene
ECB - ethylene-bitumen copolymer
ECO - epichlorohydrin-ethylene oxide copolymer
EPDM - ethylene-propylene diene rubber
ESC - environmental stress cracking
EVA - ethylene vinyl actetate copolymer
FML - flexible membrane liner
g - gram
hr - hour
HAC - hydraulic asphalt concrete
HDPE - high density polyethylene
IIR - isobutene-isoprene copolymer (butyl rubber)
LDPE - low density polyethylene
m - meter
mils - thousands of an inch
mm - millimeter
NSF - National Sanitation Foundation
PE - polyethylene
PVC - polyvinyl chloride
PVC-OR - oil resistant polyvinyl chloride
s - second
SA - soil asphalt
SC - soil cement
wt - weight
XR-5 - proprietary polymer

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1. INTRODUCTION

BACKGROUND

With increasing public awareness of the extent to which chemicals can move through the earth to aquifiers, streams and lakes, there has been an increase in the attention directed towards ensuring the long-term integrity of waste containment systems (impoundments and landfills) leading to more stringent containment regulations (U.S. EPA, 1982). The focus of these regulations has been materials that are used to line and cap waste sites to prevent water entry and waste liquid escape. These materials are principally clays and synthetic polymers. The latter group includes flexible membrane liners (FMLs) which are the subject of this study. FMLs are installed in the form of sheeting that typically is several feet wide, 0.02 to 0.1 inches in thickness (20 to 100 mils), and as long as practical for each site. The sheets are seamed to one another at the site.

At present there are four primary and several secondary base polymeric materials from which the sheeting is fabricated. Some of these materials are used alone while others are combined with fabrics for support. The process for selection of the particular liner material and construction type for any given application involves defining the requirements imposed by the site, the containment duration, and the waste. The objective, of course, is a liner that will not allow the leakage of the waste or the leachate from the site to the surrounding soil. While leakage may occur as the result of tears, punctures, cracking or seam opening caused by subsidence or other physical occurrence, the integrity of a liner system can also be compromised by degradation of the liner due to chemical attack. Chemical attack can weaken the liner and increase the likelihood for physical failures and leakage. It may also result in increased chemical permeation of the liner. The resistance of the liner material to chemical attack and permeation are important considerations in selecting the liner.

Among the many various liner materials and formulations, it is likely that a wide range of chemical resistance will exist for any one chemical. For this reason, chemical resistance testing is conducted by the liner industry, by those organizations which are contemplating the installation of a waste impoundment facility, and by various governmental agencies. Although these groups have conducted a significant amount of testing, the comparison of their results has been difficult because there have been no standard procedures for testing and reporting the findings (Tratnyek, et al., 1984). Furthermore, the findings are scattered throughout the technical literature, government reports and vendors' brochures, and proprietary literature.

PURPOSE AND SCOPE

The objective of this study was to gather, analyze and report existing chemical resistance information on a common basis. The purpose of this compilation is to assist liner material manufacturers, vendors and purchasers, and those involved in reviewing waste site permit applications in ensuring that, at least from the chemical resistance standpoint, the most appropriate material is installed at any given waste site.

Chemical resistance information was collected from the open literature and from brochures and data sheets obtained from the liner industry. While the focus was on liners fabricated from synthetic polymers (so-called flexible membrane liners [FML]), asphalt liners were also addressed. Both quantitative and qualitative resistance information was found.

The information was compiled in a computer data base. All information pertinent to a given liner/chemical pair could be retrieved as a single block of data. The data were reviewed relative to guidelines for chemical resistance proposed in this study. On the basis of this review, the resistance of the liner to the chemical was judged. The individual judgments were summarized in the form of a matrix. The matrix is organized such that the chemical resistance ratings for all chemicals of a given family (e.g., aldehydes, ketones, etc.) are reported together.

All essential information of the data base has been tabulated and is included as an appendix to this report for those who may want to independently assess chemical resistance or for those who may be involved in research utilizing chemical resistance data.

2. BACKGROUND

FLEXIBLE MEMBRANE LINER MATERIALS

Flexible membrane liners are produced from mixtures of one or more base polymers with additives that may facilitate processing, provide desired physical properties, and/or protect the base polymer(s) from the effects of exposure to weather and soil burial. Except for highly compounded FMLs such as polyvinyl chloride, the base polymer is the main determinant of the ultimate chemical resistance of an FML. The chemical resistance of any polymer is principally a function of its chemical structure, molecular weight, crystallinity, and degree of crosslinking. Each of these factors also influences a polymer's physical properties.

The base polymers most commonly used for FMLs are:

- chlorinated polyethylene (CPE)
- chlorosulfonated polyethylene (CSPE)
- high density polyethylene (HDPE)
- polyvinyl chloride (PVC)

Most of the chemical resistance data presented in this report are for these materials.

A second group of base polymers that are less widely used, and for which limited data are available, include:

- polychloroprene (Neoprene)
- poly(isobutene-co-isoprene) (butyl rubber)
- poly(ethylene-co-propylene); ethylene-propylene-diene rubber (EPDM)
- polyepichlorohydrin and its copolymers
- polyester elastomers
- thermoplastic polyolefin rubbers

All these materials have been described elsewhere. (U.S. EPA, 1983 and Kays, 1977)

CHEMICAL RESISTANCE ASSESSMENT METHODS

Introduction

The chemical resistance of any material is related to the ability of that material to perform its intended function during and/or after contact with a chemical. If there is no change in its ability to function as designed, the material is said to be resistant to the chemical. In the case of flexible membrane liner materials, the material is intended to function as a barrier to the movement of waste or its leachate into the underlying soil. Chemical resistance then should be rated as to the ability of the material to prevent the passage of waste/leachate or certain components of these liquids.

The barrier can be breached by (1) chemical interactions that reduce the physical properties of the FML to a point where failure occurs under the stresses present at the waste site or (2) by permeation of the waste or its components through the FML. The latter may occur with little or no noticeable effect on the physical properties of the liner material.

In the following paragraphs the principal means by which chemical resistance is measured are reviewed. More detail may be found in Tratnyek et al., 1984.

In assessing chemical resistance, the FML industry relies heavily on the results of physical property testing of liner materials following short-term immersion in neat chemicals, wastes, or leachates. The results are compared to the properties of an unexposed specimen. Two procedures attempting to formalize industry practices have recently been promulgated (NSF, 1983 and EPA, 1984). While a consensus has not yet evolved, it would appear that significant changes in one or more of the following physical characteristics are indicative of lack of chemical resistance:

- Weight
- Dimensions
- Tear strength
- Tensile strength
- Percent elongation at break
- Modulus of elongation
- Hardness

In addition, semicrystalline polymers may also exhibit stress cracking as a sign of poor chemical resistance. Correlations between changes in these physical properties and changes, if any, in the barrier effectiveness of the FML have not been developed.

Weight Change - The measurement of change in weight of a polymeric material resultant from exposure to or immersion in a chemical/waste is probably the simplest and most telling means for quickly assessing chemical resistance. A gain in weight indicates that the chemical can penetrate the material and, therefore, is likely to permeate the material.

Sorption of a chemical can also result in a loss of physical properties. A weight loss indicates that some component of the compound is extracted by the chemical; this could result in a change in the physical properties of the liner material and ultimately failure in cases where critical properties are significantly changed. The extraction of plasticizers from PVC is an example.

Dimensions - Changes in the physical dimensions of a polymeric specimen are often directly associated with weight changes and are also indicative of chemical interaction with the liner formulation. Again, increases or decreases in dimensions may occur, dependent on the formulation and chemical.

Tear Strength - Tear strength is the force required to tear a specimen with or without a controlled flaw. Tear strength is an indication of the mechanical strength of the liner material. A variety of tests are used, depending upon type of material and whether it contains fabric reinforcement. Chemical exposure may adversely affect performance of the reinforcing fabric (scrim). One of the purposes of scrim is to minimize the tear potential.

Percent Elongation at Break - The percent elongation at break is determined by stretching a liner specimen until it breaks and comparing its length at break to its original length. Elongation is a measure of the ability of the polymer molecules to reorient themselves, change conformation and stretch. Chemical penetration is typically, but not always, exhibited by a reduction in the percent elongation at break. (A small amount of absorption of a chemical can also result in an increase in elongation.) Reduced elongation also results when the chemical reacts with the polymer and thereby reduces its molecular weight. Percent elongation at break is strongly dependent on temperature, rate of stretching, crosslink density, crystallinity and several other factors related to the polymer morphology and formulation. For these reasons, comparison of the percent elongation at break for different types of polymers can frequently lead to erroneous conclusions. Furthermore, it is important to differentiate between elongation at break and elastic limit. Elastic limit is the percent elongation up to which a polymer may be stretched and, upon removal of the stress, return to its initial length. HDPE, for example, has a percent elongation at break exceeding several hundred percent; however, its elastic limit (i.e., its elongation at yield) is on the order of 10%.

Tensile Strength - The tensile strength is the force per unit cross-sectional area required to break a test specimen. Chemical attack is typically exhibited by a reduction in tensile strength although extraction of plasticizer or chemical attack causing embrittlement will likely result in an increase in tensile strength. Comparison of tensile strength data is subject to all the considerations described above for elongation at break.

100% and 200% Modulus - 100% and 200% moduli are the forces per unit area required to elongate a test specimen either 100% or 200%. Again, chemical attack would most likely be exhibited by a reduction in the 100% or 200% modulus, except in cases of plasticizer extraction or embrittlement.

Hardness - Hardness is a measure of the ability of a material to resist indentation by a probe of specified dimensions under specific loads. Two scales are generally used: Shore A for soft materials and Shore D for harder materials. A resistant FML material would exhibit no change in hardness while one that is penetrated by a chemical would typically soften. A material from which plasticizer was extracted would become harder.

Environmental Stress Cracking - Semicrystalline polymers, such as high density polyethylene, are subject to stress cracking under certain environmental conditions. These conditions include forces that put the surface of the membrane in tension for extended periods at the same time the membrane is exposed to a weak solvent or strong aqueous surfactant. Under conditions of long-term strain, stress cracking resistance generally varies inversely with the crystallinity of the polymer. Thus, there is a desire on the part of the vendors to hold crystallinity as low as possible to minimize stress cracking while at the same time maintaining sufficient crystallinity to provide adequate chemical resistance. A balance is required. In HDPE liner materials, this can be achieved with ethylene/propylene block copolymers in which the propylene portion of the molecule interferes to a small but significant degree with the crystalline structure that is characteristic of a HDPE homopolymer. This reduces the tendency for stress cracking. The overall crystallinity, however, is only slightly reduced and the polymer retains most of its strength and chemical resistance characteristics. For example, one supplier (Phillips, #4341) of HDPE resin for FML applications recommends the use of a 0.95 density copolymer where resistance to environmental stress cracking can occur.

As noted by Tratnyek _et al_. (1984), testing for environmental stress cracking is apparently not performed (or at least not reported upon) by suppliers of membranes potentially susceptible to this failure mode.

Although certain classes of chemicals are more likely than others to cause stress cracking, environmental stress cracking cannot be generally predicted and so must be determined experimentally. There are a variety of tests and conflicting results are not uncommon. A review of the most common methods can be found in the Modern Plastics Encyclopedia (Agranoff, 1983).

In addition to the above physical property tests, the chemical resistance of FML materials can also be measured by permeation testing. This was discussed by Schwope _et al_. (1983) and more recently by Surprenant _et al_. (1984). Both studies present data indicating that:

- Chemicals readily permeate polymeric materials typical of those used in FMLs.
- For any given chemical, the permeation rate is a function of the polymeric material.
- Permeation rates for certain chemicals/FML pairs can greatly exceed the minimum performance levels required for clay-type liners.

Permeation (Transmission) Rate - The movement of a chemical through a non-porous polymeric sheet occurs by a three-step process involving:

- The sorption of the chemical at one surface of the sheet.
- The diffusion of the chemical through the sheet.
- The desorption of the chemical into the medium in contact with the other surface of the sheet.

This process is classically described by Fick's laws and has been reviewed relative to FMLs by Haxo _et al_. (1984) and Schwope _et al_. (1983). The process takes place on a molecular basis in contrast to bulk flow through porous media such as soils.

Briefly, diffusion in a polymeric membrane is determined by the chemical concentration gradient across the sheet (i.e., the driving force) and the ease with which the chemical molecules can move through the network of polymer molecules. The ease of movement is quantified by a parameter called the diffusion coefficient. The diffusion coefficient is a property of each chemical/material pair and can be a function of chemical concentration. Both the concentration gradient and the diffusion coefficient can be influenced by temperature and the presence of other chemicals.

The sorption/desorption steps are strongly influenced by the relative affinity of the chemical for the polymer and for the medium contacting the polymer. Chemicals with high affinities for the polymer will develop relatively higher concentrations at the polymer surface contacting the chemical. This is typically exhibited by a high percentage weight change in an FML immersion test. The concentration gradient that forms within the membrane will be dependent on the relative rates of diffusion and desorption. If desorption is fast relative to diffusion, the chemical concentration at the surface where desorption is occurring will be low, and may even approach zero. This is the case of maximum permeation rate. Where desorption is hindered by a contacting phase (say, dense clay) which has little affinity for the chemical or itself presents a diffusional resistance to the chemical, the concentration at the desorption surface will increase; the gradient will decrease; and the permeation rate will be slowed.

The remainder of this section presents a summary of publicly available chemical resistance information and data pertinent to FMLs. This information is tabulated in Appendix B and is the basis for the FML chemical resistance matrix presented in Section 3.

INFORMATION AND DATA SOURCES

The first of the three objectives of this program was to gather publicly available information pertinent to the chemical resistance of liner materials. Input was solicited from the FML industry and from university and independent researchers; in addition, an extensive literature search was conducted. Information was obtained from a variety of sources, the principal ones being the vendors of the liners and liner materials who provide chemical resistance tables as part of their product literature, and the reports of government sponsored research. The tables typically contain qualitative ratings of resistance upon exposure to neat chemicals. The ratings are usually in the form of a three- or four-grade scale, such as "excellent," "good," "fair," and "not recommended." An explanation of how the ratings were arrived at did not usually accompany the ratings, nor was it readily provided by most vendors.

In a few cases, test data were obtained from vendors. These data usually consisted of weight or tensile property changes with time.

The other significant source of data was reports from government-funded studies of liner materials. These reports contain considerable test data for neat chemicals and, in many cases, for liners exposed to waste mixtures. Unfortunately, the wastes were inadequately characterized and, therefore, were of little use in forming generalizations on chemical resistance. (See Sections 3 for additional discussion of the resistance of liners to waste and water.)

Information was obtained for 23 liner materials upon exposure to approximately 549 chemicals or wastes in nine different types of tests at several times and temperatures.

INFORMATION HANDLING

In order to facilitate the generation of an overall chemical resistance matrix for FML materials, the information was organized by means of a commercially available and widely used computer data base system: FOCUS (Information Builders, Inc., New York, NY).

The key field for each record was the Chemical Abstracts Registry Number of the chemical of concern. Mixtures of wastes, which do not have Chemical Abstracts Registry numbers, were assigned numbers. The chemicals were also assigned to a chemical class (for example, inorganic acids, amines, ketones) and each class given a code number. Depending on the type of information available, the record also contained the type of liner, vendor's resistance rating, temperature for the rating, the type of test performed, the exposure conditions and time, test results, and fields for referencing information sources. The types of liner materials and tests for which published data were found are listed in Tables 1 and 2, respectively.

Qualitative ratings of chemical resistance were normalized to a common scale of an "a," "b," "bc," "c," and "d," where "a" is most resistant and "d" is least resistant. The normalization scheme for the ratings of each vendor is shown in Table 3.

TABLE 1. LINER MATERIALS

Code[1]	Description
HDPE/EPDM	High density polyethylene/EPDM alloy
HDPE	High density polyethylene
LDPE(Copol)	Low density polyethylene copolymer
EVA(Copol)	Ethylene vinyl acetate copolymer
CSPE	Chlorosulfonated polyethylene
CR	Polychloroprene
EPDM	Ethylene-propylene-diene terpolymer
IIR	Isobutene-isoprene copolymer (butyl rubber)
CO	Polyepichlorohydrin
ECO	Epichlorohydrin-ethylene oxide copolymer
CPE	Chlorinated polyethylene
PVC	Polyvinyl chloride
Polyester	Polyester elastomer
AC	Asphalt concrete
HAC	Hydraulic asphalt concrete
SC	Soil cement - 95 parts soil, 5 parts clay, 10 parts cement, 9 parts water
SA	Soil asphalt - 7 parts asphalt, 100 parts soil
ASPH	Asphalt
ECB	Ethylene-bitumen copolymer
PVC-CPE	Polyvinyl chloride-chlorinated polyethylene blend
CPE/PE/CPE	Laminate of CPE and PE
XR-5	XR-5® (Seaman Corporation)

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[1] As used in the Chemical Resistance Matrix in Section 3

TABLE 2. CHEMICAL RESISTANCE TESTS

Description	Data Reported As	Test Code*
Permeation	$g/m^2/hr$	1
Immersion followed by dimensional measurements	% swelling	2
Immersion followed by measurement of elongation at break	% change in elongation at break	3
Immersion followed by weighing	% weight change	5
Immersion followed by determination of tensile strength at break	% change in maximum strength	7
Immersion followed by determination of stress at 100% elongation	% change in 100% modulus	8
Hardness	Hardness points change	9
Immersion followed by determination of stress at 200% elongation	% change in 200% modulus	10
Soil permeability	cm/s	11

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*Test code numbers are used in column 5 of the data tables presented in Appendix B

TABLE 3. NORMALIZATION OF VENDOR AND LITERATURE QUALITATIVE RATINGS* TO COMMON (NORMALIZED) RATING SCALE

Source		Normalized Rating				
Name	Code	a	b	bc	c	d
Dow, 1982	DW	S				U
Du Pont, 1981	DU	A		B		C
Gulf, 1982	GF	A		B		C
Gundle, 1981	GU	O		M		S
Hercules, 1981	HE	E		G		P
Kays, 1977	14	OK		Q		NR
NACE, 1966	18	R				
Phillips, 1983	PH	E,S	G	O	F	P,U
Sarnafil, 1982	SF	+	⊕	±	0,⊖	–
Schlegel, 1981	SL	S		L		U
Seaman, 1981	SE	S		M		C
U.S. EPA, 1978	31	G		F		P

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*See following pages (footnotes) for description of vendor and literature ratings.

TABLE 3 (continued)

FOOTNOTES

Source	Symbol	Description
Dow	S	Laboratory data or field experience indicate satisfactory service likely
	U	Not recommended, unsatisfactory service likely
Du Pont	A	Fluid has little or no effect
	B	Fluid has minor to moderate effect
	C	Fluid has severe effect
Gulf	A	Excellent
	B	Fair
	C	Poor
Gundle	O	No effect
	M	Moderate effect
	S	Severe effect
Hercules	E	Less than 10% change in volume, ultimate elongation, or tensile
	G	Less than 30% change in volume
	P	More than 30% change in volume
Kays	OK	Generally satisfactory
	Q	Questionable
	NR	Not recommended
NACE, 1966	R	Resistant
Phillips	E	No effect
	G	Slight absorption but little or no effect on physical properties
	F	Loss of physical properties
	P	Significant loss of strength, softening, embrittlement
Phillips	S	Satisfactory
	O	Some attack
	U	Unsatisfactory

TABLE 3 (continued)

Source	Symbol	Description
Sarnafil	+	Resistant
	⊕	Practically resistant
	±	Degree of resistance dependent on concentration of chemical
	0,θ	Restricted resistance only*
	-	Not resistant
Schlegel	S	Satisfactory
	L	Limited application possible
	U	Unsatisfactory
Seaman	A	Fluid has little or no effect
	M	Fluid has minor to moderate effect
	C	Fluid has severe effect
U.S. EPA, 1978	G	Good
	F	Fair
	P	Poor

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*Restricted resistance is not defined by the manufacturer, but is assumed to mean that material is resistant only under certain conditions. Chemical/materials combinations with this rating should probably be avoided.

Once the data had been compiled, they could be retrieved on a chemical-by-chemical basis, chemical class basis, liner material basis, test-type basis, and so forth. The complete listing of the normalized ratings and data for each liner material is provided in Appendix B.

DATA LIMITATIONS

The organization and consolidation of chemical resistance information necessarily required grouping liner materials by generic type. Regardless of liner formulation or supplier, all information for a given base polymer was categorized together. While this approach facilitated data handling, it suffers an important drawback: the final conclusions on chemical resistance (see Section 3) may misrepresent the performance of any given type or brand of liner material. This is particularly a problem where only one source of information was found for a single liner/-chemical pair. On one hand, if that information is for a liner material that had been especially formulated for the specific waste/chemical, then the information could lead one to a detrimentally false conclusion about other liners in the same generic class. On the other hand, information indicating poor performance could wrongly lead one from investigating the possibility of upgrading the formulation for a specific application. The sources and types of information for each liner addressed in this study are identified in Table 4.

The degree to which the classification of liner materials into broad generic classes could potentially lead to erroneous conclusions on resistance varies from liner to liner as demonstrated by the following discussion. The chemical resistance of HDPE is dependent on polymer composition (copolymers are typically used to minimize the potential for environmental stress cracking), density, overall crystallinity and local crystallinity gradients resultant from processing variations. However, as observed in Tables 5 and 6 there are only a few differences between products in the generic HDPE category. This lack of difference may be due to the basis for the ratings; it is not always evident whether the published information is for the base resin or for finished FML sheet.

TABLE 4. SUMMARY OF INFORMATION SOURCES AND GENERAL CLASSIFICATION OF FML MATERIALS

Generic Material	Abbreviation	Information Sources	Information Type	
			Qualitative	Test Data
Asphalt	ASPH	U.S. EPA, 1978	x	
		NACE, 1966	x	
		Kays, 1977	x	
Asphalt Concrete	AC	U.S. EPA, 1978	x	
		Kays, 1977	x	
		U.S. EPA, 1983		x
Chlorinated Polyethylene	CPE	Dow, 1982	x	
		U.S. EPA, 1978	x	
		Kays, 1977	x	
		Watersaver, Inc., 1981		x
		U.S. EPA, 1983		x
		Haxo, 1984		x
		August, 1984		x
Chlorinated Polyethylene/ Polyethylene/Chlorinated Polyethylene Laminate	CPE/PE/CPE	August, 1984		x
Chlorosulphonated Polyethylene	CSPE	Du Pont, 1981	x	
		U.S. EPA, 1978	x	
		Kays, 1977	x	
		Watersaver, Inc., 1981		x
		U.S. EPA, 1983		x
		Haxo, 1984		x

TABLE 4 (continued)

Generic Material	Abbreviation	Information Sources	Information Type	
			Qualitative	Test Data
Epichlorohydrin/Ethylene Oxide Copolymer	ECO	Hercules, 1981	x	x
Ethylene-Bitumen Copolymer	ECB	August, 1984		x
Ethylene/Propylene/Diene Terpolymer	EPDM	Du Pont, 1981	x	
		U.S. EPA, 1978	x	
		U.S. EPA, 1983		x
		Haxo, 1984		x
		August, 1984		x
Ethylene Vinyl Acetate Copolymer	EVA(Copol)	Gundle, 1981	x	
High Density Polyethylene	HDPE	Sarnafil, 1982	x	
		Gundle, 1981	x	
		Schlegel, 1981	x	
		U.S. EPA, 1978	x	
		Kays, 1977	x	
		Haxo, 1984		x
		August, 1984		x
		Gulf, 1982	x	
		Phillips	x	x
High Density Polyethylene/EPDM	HDPE/EPDM	Gundle, 1981	x	
		U.S. EPA, 1983		x
Hydraulic Asphalt Concrete	HAC	U.S. EPA, 1983		x
Isobutene/Isoprene Copolymer	IIR	U.S. EPA, 1978	x	x
		Kays, 1977	x	
		U.S. EPA, 1983		x
		Haxo, 1984		x

TABLE 4 (continued)

Generic Material	Abbreviation	Information Sources	Information Type	
			Qualitative	Test Data
Low Density Polyethylene Copolymer	LDPE(Copol)	Gundle, 1981	x	
Polychloroprene	CR	Du Pont, 1981	x	
		Kays, 1977	x	
		U.S. EPA, 1983		x
		Haxo, 1984		x
Polyepichlorohydrin	CO	Hercules, 1981	x	x
		Haxo, 1984		x
Polyester Elastomer	POLYESTER	Du Pont, 1981	x	
Polyvinyl Chloride	PVC	Sarnafil, 1982	x	
		U.S. EPA, 1978	x	
		Kays, 1977	x	
		Watersaver, Inc., 1981		x
		U.S. EPA, 1983		x
		Morrison, et al., 1971		x
		Haxo, 1984		x
		August, 1984		x
Polyvinyl Chloride-Chlorinated Polyethylene Blend	PVC-CPE	August, 1984		x
Soil Asphalt	SA	U.S. EPA, 1978	x	
		U.S. EPA, 1983		x
Soil Cement	SC	U.S. EPA, 1978	x	
		U.S. EPA, 1983		x
XR-5	XR-5	Seaman, 1983	x	

TABLE 5. COMPARISON OF THE CHEMICAL RESISTANCE INFORMATION FROM THREE HDPE VENDORS

	Normalized Rating[1] (at 20-25°C)		
	Vendor A	Vendor B	Vendor C
Carbon Tetrachloride	bc	bc	bc
Glycerol	a	-	a
Ethyl Ether	bc	bc	bc
Aniline	a	a	a
Ethanol	a	a	a
Sulfuric Acid, <30%	a	a	-
Nitric Acid, <30%	a	a	a

---

[1] See Table 3

TABLE 6. CHEMICAL RESISTANCE RATINGS (NORMALIZED) OF TWO HDPEs: SUPPLIER A's FML GRADE RESIN; SUPPLIER B's GENERIC RESIN

	Supplier A	Supplier B
Acetic Acid, 10%	a	a
Acetone	a	b
Ammonium Hydroxide, Concentrated	a	a
Amyl Acetate	a	b
Aniline	a	a
Benzene	bc	bc
Chloroform	d	d
Ethylene Glycol	a	a
Ethyl Ether	a	c
Hydrochloric Acid	a	a
Isopropyl Alcohol	a	a
Joy® Detergent, Concentrated	a	a
Mineral Oil	a	b
Nitric Acid	bc	bc
Nitrobenzene	a	d
Phenol	a	a
Potassium Chromate	a	a
Sodium Chloride, 10%	a	a
Zinc Chloride, 10%	a	a

Source: Gulf, 1982 and Phillips, 1983

The chemical resistance of PVC liners is strongly dependent on the type of plasticizer used in the compound. This is shown in Tables 7 and 8. The information in Table 8 is particularly enlightening relevant to the stability of different types of plasticizers in PVC. Note, however, that the more stable plasticizers generally are associated with PVC compounds having poorer low temperature performance.

TABLE 7. COMPARATIVE RESISTANCES OF A STANDARD AND AN OIL RESISTANT (OR) FORMULATION OF 30 mil PVC

	Resistance (Normalized)	
	PVC	PVC-OR
Acids	ab	ab
Bases	bc	bc
Metallic Salts	a	a
Oils	cd	ab
Solvents	d	c
Glycols	b	b
Water	a	s
Alcohols	-	c
Fuels	-	b

Source: Pantosote, 1980

TABLE 8. STABILITY OF PVC TO PLASTICIZER EXTRACTION BY KEROSENE AT 23°C. EXPOSURE 1 DAY. INITIAL PLASTICIZER CONCENTRATION 40%

Plasticizer	Low Temperature, Flex, Before Extraction (°C)	Extraction
Di-2-ethylhexyl adipate	- 66	>70
Tri-2-ethylhexyl thiosphate	- 70	74
Di-2-ethylhexyl phthalate	- 39	44
Polyethylene glycol di-2-ethylhexoate	- 55	26
Diallyl phthalate	- 42	18
Tri-n-butyl citrate	- 39	8
Di-2-ethylhexyl isophthalate	- 42	7
Di-ethyleneglycol dibenzoate	- 17	4
Epoxidized soybean oil	- 27	3

Source: Darby and Sears, 1976

3. CHEMICAL RESISTANCE

INTRODUCTION

The chemical resistance information in Appendix B comprises two groups: normalized qualitative ratings and laboratory test results. The objective was to summarize this information, after compilation, on a common basis in a form that would serve various groups interested in the use of FMLs for waste containment. The format selected was a matrix in which chemical resistance, reduced to resistant and non-resistant ratings could be shown on a chemical-by-chemical basis for each generic class (base polymer) of liner material. A scheme was devised that would indicate chemical resistance as derived from either the qualitative ratings and/or from an evaluation of laboratory results.

The ratings are intended to be used only as general guidance in assessing the potential performance of a liner. A favorable rating is no guarantee that the liner will perform successfully; nor should an unfavorable rating be taken as an absolute indicator of unacceptability for a given application. There are no known correlations between the liner material performance in short-term laboratory tests and likely performance over decades in the field. Nevertheless, it is useful to compile and assess what information is available to help reach intelligent decisions regarding the installation of flexible membrane liners.

The criteria developed in this study and applied to test data for judging chemical resistance of liner materials are based on technical judgment and are in general concurrence with similar attempts by other investigators. The criteria, however, have not been proposed to, nor adopted as standards by, the EPA or any independent organization. The criteria represent a starting point for developing chemical resistance standards for liner materials. All information on which the ratings are based is presented in order to facilitate other interpretations (Appendix B). As more information from the laboratory and field becomes available, the data base can be expanded and the criteria modified to reflect experience.

ANALYSIS OF CHEMICAL RESISTANCE INFORMATION

Qualitative Information

As discussed earlier, chemical resistance is commonly described by resin suppliers, liner vendors and, in some cases, the technical literature in qualitative terms such as "excellent," "fair," and "poor." The terms used used by various sources are not consistent, nor are the number of grades in the ratings scales. For this reason, ratings have been normalized according to the scheme given in Table 3. With reference to the table, "a" and "b" ratings have arbitrarily been taken as indicative of a resistant material and the ratings of "bc," "c," and "d" as representative of a material that is not resistant.

Test Data for Materials Other than HDPE

To some degree, all polymeric materials are permeable to virtually all chemicals. A difficulty arises, however, in that the acceptable amount of permeation will be dependent on a wide variety of factors including the toxicity of the chemical, the area of the site, the hydrogeology, and so forth. These factors and the unavailability of laboratory-to-field correlations were recognized in two recent guidance documents from the EPA (U.S. EPA, 1985 and 1985a). However, in these documents the Agency also established a guideline value for *de minimis* leakage as 1 gallon/acre/day until such time that data become available to warrant a change. This value was adopted as the maximum acceptable permeation rate for an FML to be considered resistant.

For a permeant having the density of water, 1 gallon/acre/day is equivalent to 0.9 $g/m^2/hr$, units that are more commonly used to express the results of laboratory tests.

Very little permeation testing of membrane liner materials has been performed to date. However, the recent publications by Haxo *et al*. (1984) and August *et al*. (1984) are indicative of a growing awareness of the importance of this parameter in the evaluation of liner materials. As more data become available, further attention will be directed to improving the approach for estimation of acceptable and unacceptable permeation rates.

Present test data from which chemical resistance may be judged are typically in the form of weight, dimensional, or tensile property changes due to immersion in the chemical or waste. Since there are no standards by which to judge the resistance of liner materials using the results from such tests, a set of working guidelines was developed in this study by which the immersion data could be assessed. The rationale for the guideline values is given below. It is again emphasized that the guidelines are not intended to be used as a rule by which liners are either accepted or rejected for any given application. They are *guidelines* only, intended to provide one perspective from which information can be analyzed. For applications where these guidelines are not appropriate, the reader is referred to Appendix B where the underlying data are summarized on which to base alternative interpretations.

The guidelines used in this study for judging chemical resistance are summarized in Table 9. The most prevalent type of immersion data is that of weight change. In an extensive study of rubber liner materials for tanks, Carpenter and Fisher (1981) found that weight changes of <10% in thirty days had no significant effect on performance. This limit was adopted as the guideline value for the assessment of FML materials other than those which are HDPE-based. Similarly, ±10% was adopted as the range within which shrinkage or swelling (i.e., volume change) would not be expected to hinder liner performance. This is lower than the ±30% range suggested by Exxon (1976), but it is justified given the relatively severe conditions to which liners may be exposed.

TABLE 9. CRITERIA FOR CHEMICAL RESISTANCE[1]

	Resistant (+)[2]	Not Resistant (-)
Permeation Rate	<0.9 g/m²/hr	>0.9 g/m²/hr
Change in weight	<10%	>10%
Change in volume	<10%	>10%
Change in tensile strength	<20%	>20%
Change in percent elongation at break	<30%	>30%
Change in 100% or 200% modulus	<30%	>30%
Change in hardness	10 points	10 points

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[1] For materials other than HDPE
[2] +, -; symbols used in the chemical resistance matrix

The 20%, 30%, and 30% values for the limits of tensile strength, elongation, and modulus change, respectively, are generally consistent with industry rules-of-thumb. For example, the information presented in a summary of chemical resistance data for CPE is in the form of both tensile test data and qualitative ratings of resistance (Dow, 1980). Comparison of the data and the ratings shows that, in general, ratings of excellent or good chemical resistance are given where the chemical produced less than 20-30% changes in tensile strength and elongation. Several manufacturers of liners or similarly composed products have concurred that these values were reasonable as benchmarks for an initial judgment of chemical resistance. However, liner manufacturers cautioned that the results from one type of test are not usually sufficient to characterize chemical resistance, and that such results must be used with caution and particular consideration to the intended application of the membrane.

The final guideline suggested in Table 9 is one for change in hardness. The work of Carpenter and Fisher (1981) suggests that a change of less than 10 points in Durometer indicates chemical resistance, and this value was adopted.

Exceptions to the above criteria involve CPE and PVC data for exposure to water and leachate from municipal solid wastes. In these cases weight change and elongation that exceed the Table 9 limits have been reported but, nevertheless, the materials appear to have performed satisfactorily.

Test Data for HDPE

For semi-crystalline materials, such as HDPE, any given percentage change in one or more physical properties is likely to have a relatively greater impact on performance. Thus in the Modern Plastics Encyclopedia (Agranoff, 1983), the guidance shown in Table 10 is given.

TABLE 10. EFFECTS OF CHEMICALS ON THE PHYSICAL PROPERTIES OF HDPE

Effect of Chemical	Change in Weight, %	Change in Dimensions, %	Change in Tensile Strength, %
Usually not significant	<0.5	<0.2	<10
Significant but usually not conclusive	0.5-1.0	0.2-0.6	10-20
Usually significant	>1.0	>0.5	>20

Source: Modern Plastics Encyclopedia (Agranoff, 1983)

Further insight can be gained from review of test data and qualitative ratings provided by resin suppliers. In Table 11, the percentage changes in weight, elongation and tensile strength due to immersion in 19 chemicals for three months at 27°C are tabulated along with the qualitative resistance ratings provided by the resin supplier (Phillips, 1983). In general, excellent/satisfactory or good ratings were assigned (by Phillips) in those cases where the tensile, elongation, and weight change were below 4%, 30%, and 2%, respectively; and fair or poor/unsatisfactory ratings were applied for cases having property changes above these limits. There are four exceptions: benzaldehyde, amyl acetate, benzene and nitrobenzene.

One HDPE liner supplier (Schlegel, 1982) considers a 3% change in weight and a 10% change in tensile properties as the pass/fail criteria. The immersion conditions are 28 days at 70°C (158°F).

The three sets of criteria cited above have been combined to establish guidelines for evaluating HPDE data base as summarized in Table 12. The permeation rate value suggested earlier is also included among the HDPE criteria. Values for elongation at break, 100% and 200% modulus and hardness are less informative or not pertinent for HDPE-based materials and are not included in the table.

TABLE 11. PERCENTAGE CHANGE IN THREE PHYSICAL PROPERTIES FOLLOWING 3-MONTH, 27°C IMMERSION OF HDPE SPECIMENS

Chemical	Resistance Rating[1] / Property[2]	E or S			G			F			P or U		
		T	E	W	T	E	W	T	E	W	T	E	W
Battery Acid (36%)		-2.6	- 4.3	-0.013									
Hydrofluoric Acid (52-55%)		-3.1	+13.0	+0.006									
Phosphoric Acid (85%)		-0.37	0	0									
Chromic Acid (25%)		+0.15	0	-0.55									
Hydrochloric Acid (37%)		-0.43	- 4.3	+0.037									
Nitrobenzene											- 3.85	+ 30.4	+ 2.25
Phenol		-0.15	+ 4.3	+2.7									
10 Wt. Motor Oil					- 3.5	+ 21.7	+1.87						
Hydrogen Peroxide 30%		-3.4	+ 8.7	+0.01									
Clorox		-1.0	+ 1.1	+0.01									
Tetralin											-12.7	+ 82.6	+ 7.08
Benzaldehyde		-7.0	+17.6	+2.08									
Chlorobenzene											- 6.9	+ 34.8	+ 5.33
Toluene											-11.8	+ 56.5	+ 4.40
Mineral Oil					- 2.0	+ 26.0	+0.82						
Aniline		-1.7	+ 4.3	+0.76									
Xylene											-13.3	+113.0	+ 5.29
5% Soap Solution		-3.0	+30.4	+0.061									
Ethyl Alcohol		-0.43	+17.4	+0.26									
Amyl Acetate					-10.6	+104.3	+3.31						
Turpentine											-13.6	+152.2	+ 6.65
Ethyl Acetate								-7.4	+95.7	+2.23			
Carbon Tetrachloride											-11.5	+ 47.8	+14.0
Benzene					- 6.5	+ 4.3	+5.5						
NH_4OH (28%)		+0.87	0	+0.015									

---

[1] E = Excellent, S = Satisfactory, G = Good, F = Fair, P = Poor, U = Unsatisfactory

[2] T = Tensile Strength, E = Elongation, W = Weight

Data Source: Phillips

TABLE 12. CRITERIA USED IN RATING THE CHEMICAL RESISTANCE OF HIGH DENSITY POLYETHYLENE

	Resistant (+)[1]	Not Resistant (-)
Permeation Rate	<0.9 g/m²/hr	>0.9 g/m²/hr
Change in Weight	$< 3\%$	$\geq 3\%$
Change in Dimension	$< 1\%$	$\geq 1\%$
Change in Tensile Strength	$<20\%$	$\geq 20\%$
% Elongation at yield	$<20\%$	$\geq 20\%$

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[1] +, -: symbols used in the chemical resistance matrix

Again, it is emphasized that these criteria were established for the purposes of this study and do not necessarily represent a consensus. There is no known correlation between meeting these criteria and either long- or short-term liner performance. However it is believed that the criteria represent a reasonable starting point for judging the potential suitability of HDPE-based FMLs. Certainly any situation in which a chemical, leachate, or waste caused changes greater than the table criteria should be carefully evaluated.

CHEMICAL RESISTANCE MATRIX

The qualitative and quantitative criteria described in the previous section were applied to the information in Appendix B in order to judge the chemical resistance of each liner type on a chemical-by-chemical basis. Ratings were generated for approximately 550 chemicals and 23 types of FML and are summarized in Table 19--Chemical Resistance Matrix at the end of this section. Preceding the matrix are discussions on the use and limitations of the matrix and three specific topics: wastes, water, and environmental stress cracking.

Rating System

For any given chemical/liner material pair, there may be two ratings: one based on quantitative test data, and the other on qualitative information.

The format for the ratings is to use a "+" for cases in which the liner material was judged resistant to the chemical, and a "-" where the information indicates that the liner is not resistant. The ratings for the quantitative and qualitative information are separated by a vertical line with rating based on test data to the left of the line. Where no information was available, no rating was formed and a blank appears in the Table 19. The various combinations of ratings are described in Table 13. This scheme provides insight to where the qualitative information is either supported or not supported by laboratory test results.

TABLE 13. KEY TO RESISTANCE RATINGS SHOWN IN TABLE 19

<table>
<tr><th>Rating</th><th>Test Data</th><th></th><th>Qualitative Information</th></tr>
<tr><td>+|+</td><td>Good resistance to chemical</td><td>and</td><td>Favorable ratings</td></tr>
<tr><td>+|</td><td>Good resistance to chemical</td><td>and</td><td>No qualitative ratings</td></tr>
<tr><td>|+</td><td>No test data</td><td>but</td><td>Favorable ratings</td></tr>
<tr><td>+|-</td><td>Good resistance to chemical</td><td>but</td><td>Unfavorable ratings</td></tr>
<tr><td>-|+</td><td>Poor resistance to chemical</td><td>but</td><td>Favorable ratings</td></tr>
<tr><td>-|</td><td>Poor resistance to chemical</td><td>but</td><td>No qualitative ratings</td></tr>
<tr><td>|-</td><td>No test data</td><td>but</td><td>Unfavorable ratings</td></tr>
<tr><td>-|-</td><td>Poor resistance</td><td>and</td><td>Unfavorable ratings</td></tr>
</table>

Using the Chemical Resistance Matrix

The format of the Chemical Resistance Matrix (Table 19) has the liner materials listed across the top of each page and the chemicals listed vertically down the left side. Liner materials not listed across the top had relatively less resistance information and are addressed under the "OTHER MATERIALS" heading.

The chemicals are organized by chemical class based on a system used by the Eastman Kodak Company in its catalog of laboratory chemicals (1981). Additional classes and subclasses have been added as necessary. The complete listing of chemical classes is given in Table 14. Since chemicals in the same class often behave similarly, listing the chemicals by class may provide some insight into the possible resistance of liner materials to chemicals for which no information has been included in the matrix.

To determine if a certain chemical is included in Table 19 and its class, the matrix user is referred to Appendix A. There the chemicals are listed alphabetically with their Chemical Abstract Registry number (CASNO) and class number. The matrix is organized sequentially by class.

The Chemical Resistance Matrix is also useful for determining whether or not the chemical resistance of a particular chemical/liner material pair has been tested and locating the report containing the results. Any chemical/material pair that has been tested and the results included in this analysis is indicated by a plus or minus to the left of the vertical bar of the rating. The test results supporting that rating are presented in the data tabulation presented in Appendix B. Along with the data and in the rightmost column of that appendix is the reference to the source of the data. Appendix B is organized according to liner type. The chemicals are listed alphabetically under each liner type.

Blanks in the Chemical Resistance Matrix indicate data gaps and may serve to direct future testing and research.

Limitations of the Chemical Resistance Matrix

The chemical resistance matrix of Table 19 was designed to organize on a common basis the wide diversity of chemical resistance information available on flexible membrane liner materials. Supplemented by the data in Appendix B, the ratings provide preliminary insight to help guide further laboratory and field investigations related to the application of polymeric sheets as means for waste containment. However, it must be reemphasized that, in many cases, the ratings are severely lacking as the basis from which to select or reject a liner. For example, most tests are conducted with neat chemicals. In actual use liners are more likely to be exposed to dilute and/or multiple component solutions. In addition, an installed liner may be under significant physical stress, whereas most laboratory

TABLE 14. LISTING OF CHEMICAL CLASSES COMPOSING THE FML RESISTANCE MATRIX

Chemical Class	Class Number
ACIDS, CARBOXYLIC	
Unsubstituted	102
Substituted	103
Polybasic	104
Aromatic	105
ALDEHYDES	
Aliphatic and Alicyclic	121
Aromatic and Heterocyclic	122
AMIDES	132
AMINES, ALIPHATIC & ALICYCLIC	
Primary	141
Secondary	142
Tertiary	143
Polyamine	144
AMINES, AROMATIC	
Primary	145
Polyamine	147
ANHYDRIDES, CARBOXYLIC	
Aliphatic	161
CYANIDES	215
ISOCYANATES	210
ESTERS, CARBOXYLIC	
Chloroformates	221
Acetates	222
Higher Monobasic	223
Polybasic	224
Aromatic Benzoates	225
Aromatic Phthalates	226
ESTERS, OTHER THAN CARBOXYLIC	
Sulfonates	232
Others	233
ETHERS	
Aliphatic	241
Aromatic	242
HALOGEN COMPOUNDS	
Aliphatic, Unsubstituted	261
Aliphatic, Substituted	262
Aromatic, Unsubstituted	263
Aromatic, Substituted	265

TABLE 14 (continued)

Chemical Class	Class Number
HETEROCYCLIC COMPOUNDS	
Nitrogen, Pyridines	271
Nitrogen, Quinolines	272
Nitrogen, Others	274
Oxygen, Epoxy Compounds	275
Oxygen, Furan Derivatives	277
Oxygen, Others	278
HYDRAZINES	280
HYDROCARBONS	
Aliphatic and Alicyclic	291
Aromatic	292
Polynuclear	293
HYDROXYL COMPOUNDS	
Aliphatic & Alicyclic, Primary	311
Aliphatic & Alicyclic, Secondary	312
Aliphatic & Alicyclic, Tertiary	313
Aliphatic & Alicyclic, Polyols	314
Aliphatic & Alicyclic, Arylsubstituted	315
Aromatic	316
INORGANIC ACIDS	370
INORGANIC BASES	380
INORGANIC GASES	350
INORGANIC SALTS	540
KETONES	
Aliphatic & Alicyclic	391
Alkyl-Aryl	393
LACTONES	400
MISCELLANEOUS	
Miscellaneous	550
Waste Materials	999
NITRILES	
Aliphatic & Alicyclic	431
Aromatic	432
NITRO COMPOUNDS	
Unsubstituted	441
Substituted	442
ORGANO METALLIC COMPOUNDS	461
ORGANO PHOSPHORUS COMPOUNDS	460
PEROXIDES	300
QUINONES	490

TABLE 14 (continued)

Chemical Class	Class Number
SULFUR COMPOUNDS	
Thiols	501
Sulfides & Disulfides	502
Sulfoxides	503
Sulfonic Acids	504
Sulfonyl Chlorides	505
Others	507
VINYL HALIDES	530

tests are conducted with an unstressed specimens. Furthermore, most tests are conducted for relatively short times compared to the service lives intended for the liner, and there are few if any long-term field data with which to develop correlations with the short-term laboratory results.

In view of these and many other similar considerations, only the results of tests with the actual waste or an approximation of the waste under conditions that simulate as closely as possible the application conditions should be used for acceptance/rejection decisions. This is discussed in U.S. EPA (1983), Kays (1977), GCA (1984), Tratnyek et al. (1984) and Schwope et al. (1983), and is an underlying principle for the utilization of any polymeric material.

In summary, the matrix in Table 19 is a useful tool for selecting candidate materials for chemical resistance testing for a given application or for raising questions as to the appropriateness of an FML selection, but it is not a guarantee and should not be used to supersede test results.

Wastes

Most of the information available on the chemical resistance of liner materials is for neat chemicals. Information on the resistance of liners to solutions or mixtures is sparse, but some insight may be gained from U.S. EPA (1978), Kays (1977), and August and Tatzky (1984).

Data have been extracted from these sources and used as the basis for the ratings under the heading MISCELLANEOUS in the Chemical Resistance Matrix. These ratings have minimal supporting data and should be viewed with extreme caution. In most cases, the information sources provided no details as to the chemical compositions of the wastes. The solutions have only been generally described as "toxic pharmaceutical waste," "rubber and plastic waste," and so forth.

Some permeation data for well-defined, multi-component solutions have recently been reported. (August and Tatzky, 1984) In Table 15 are presented their permeation rate results for each component from an equi-part, six-component solution through 1 mm thick HDPE. For comparison, the permeation rates of the same components in neat form are also presented. For the four chemicals with data for both neat and the multi-component solutions, the rates associated with the multi-component solution are less than one-sixth of the rate for the neat chemical. It appears that for this multi-component solution the interactions among the chemicals reduces their individual aggressiveness towards chemical attack and permeation.

TABLE 15. PERMEATION RATES OF SIX COMMON SOLVENTS FROM A SINGLE MULTI-COMPONENT SOLUTION THROUGH A 1.0 mm HDPE LINER

	Concentration %	Permeation Rate $g/m^2/hr$
Trichloroethylene	100	6.3
	16.7[1]	0.39
Tetrachloroethylene	100	2.5
	16.7[1]	0.34
Xylene	100	1.3
	16.7[1]	0.13
1-Octane	100	0.07
	16.7[1]	3×10^{-3}
Acetone	--	--
	16.7[1]	0.06
Methanol	--	--
	16.7[1]	0.04

---

[1] As part of a six-component solution of the six chemicals listed.

Source: August and Tatzky, 1984.

August and Tatzky also investigated the permeation of common solvents from low concentration (<5%) aqueous solutions through several types of liner materials. Their results for HDPE are presented in Table 16. For none of the chemicals is the permeation rate proportional to concentration; it is disproportionately greater. For example for trichloroethylene permeation, the rate for a solution having 1/1000th the concentration of the neat liquid is 1/25th of that of the neat liquid. Equal permeation rates would have been expected since the chemical activity gradient across the membrane is the driving force for permeation. In a saturated solution, the chemical activity of chemical at saturation is equal to the chemical activity of that chemical in neat form. Thus, the driving force for permeation should be the same for both a saturated and a neat solution. The lower rates for the saturated solution may be due to poor mixing of the solution such that at the solution/polymer interface the local concentration was less than saturated.

TABLE 16. PERMEATION OF COMMON SOLVENTS FROM NEAT AND SATURATED AQUEOUS SOLUTIONS THROUGH 1.0 mm HDPE

	Concentration wt. %	Permeation Rate $g/m^2/hr$
Trichloroethylene	100	6.25
	0.1 (sat)	0.25
	0.1 (sat)	0.25
Toluene	100	1.67
	0.05 (sat)	0.08
Xylene	100	1.33
	0.02 (sat)	0.07
1-Octane	100	0.07
	0.001	$<4.2 \times 10^{-5}$

Source: August and Tatzky, 1984

Water

Liner materials are also permeable to water and since water, either in the ground, the leachate, or the waste is present in most liner installations, resistance to water may also be a factor in liner selection. The water permeabilities of virtually all presently used liner materials have been measured and reported by Haxo et al. (1984). The ASTM E96 inverted cup at 23°C was used with an external relative humidity of 50% and deionized water. The data from Table 3 of the Haxo report have been normalized for thickness and are represented herein as Table 17. The olefinic-based liner materials (i.e., HDPE through EPDM) are one to two orders of magnitude better barriers to water (on a per unit thickness basis) than the common chlorine-containing liner materials (i.e., Neoprene through PVC, with the obvious exception of the polyester elastomer). The permeation results are consistent with the water sorption data in Appendix B of this report and Table 10, Chapter VIII of

Brandrup and Immergut (1975). Water sorption for the olefinic-based polymers is typically less than 0.1% by weight; whereas CSPE, Neoprene, and CPE exhibited absorptions of 15-20% in 365 days.

In cases where Haxo et al. conducted tests with multiple specimens of the same generic material, the highest permeation rate was used as the basis for the liner material ranking in Table 17. The variability within some classes of liner materials may be due to formulation and/or fabrication differences between specimens. Cassidy (1983) has noted similar differences between two Neoprene formulations.

Cassidy also found that water permeation was a strong function of the type of water used. He compared deionized water with a 3.5% NaCl salt solution. For three polymers--Neoprene CR, styrene-butadiene, and EPDM--he found that permeation rates for the salt solution were greater than for the distilled water. Furthermore in tests that lasted over 300 days, the Neoprene WRT exhibited an ever increasing rate of deionized water permeation whereas the water permeation from the salt water was constant with time. In a multi-year Bureau of Reclamation study, PVC exhibited stiffening and shrinkage, both indications of plasticizer loss. (Since the time of that study, PVCs with more permanent plasticizers have been introduced to the market.) In summary, all these findings point out the importance of long-term testing and the importance of type of water on water permeation.

Environmental Stress Cracking

Information relevant to environmental stress cracking (ESC) is sparse and was not considered in the development of the ratings included in the Chemical Resistance Matrix. ESC is not readily predicted by other chemical tests such as those for weight or tensile property changes. However, some insights into the range of chemicals that can cause ESC of HDPE can be gained from review of Table 18.

TABLE 17. WATER PERMEATION THROUGH FLEXIBLE MEMBRANE LINER MATERIALS AT 23°C AND 50% R.H. PER ASTM E96 INVERTED CUP

	$g \cdot mm/m^2 \cdot d$	
	All Values	Maximum
High density polyethylene	0.01,0.02	0.02
High density polyethylene - A	0.04	0.04
Low density polyethylene	0.04	0.04
Polybutylene	0.06	0.06
Elasticized polyolefin	0.1	0.1
Ethylene/propylene/diene	0.14,0.18,0.29	0.29
Butyl rubber	0.02,0.18,0.33,0.34	0.34
Neoprene	0.16,0.38,0.43,0.54	0.54
Chlorosulphonated polyethylene	0.25,0.27,0.39,0.4,0.5,0.68	0.68
Chlorinated polyethylene	0.22,0.25,0.29,0.34,0.62,1.11	1.11
Polyvinyl chloride	1.24,1.46,1.47,1.51	1.51
Polyester elastomer	2.1	2.1
Polyvinyl chloride - E	2.53	2.53
Polyvinyl chloride - OR	3.46	3.46
Nitrile rubber	4.2	4.2
Epichlorohydrin rubber	23.5	23.5

Source: Haxo *et al*., 1984.

TABLE 18. HDPE STRESS CRACKING
("Yes" Indicative of Chemical for which Precautions should be Taken in Selection of Grade of HDPE or HDPE Copolymer)

Chemical	Can Cause Stress Cracking
Acetic Acid (all concentrations)	Yes
Acetone	No
Amyl Alcohol	Yes
Benzene	No
Butyl Alcohol	No
Chloroform	Yes
Detergents	Yes
Ethyl Alcohol	Yes
Gasoline	No
Hydrochloric Acid (all concentrations)	No
Phenol, 90%	No
Nitric Acid (up to 50%)	No
Sodium Hydroxide, 30%	No
Sulfuric Acid (all concentrations)	No
Toluene	No

Source: Phillips Publication #4341

Some chemicals that cause ESC have little or no effect on the material in an unstressed condition, for example, acetic acid, detergents, and several alcohols. Alternatively, other chemicals which swell or significantly affect physical properties are not prone to producing ESC, for example, benzene, ethyl ether, ethylene chloride, and trichloroethylene. Finally, ESC can be caused by relatively low concentrations of the attacking chemical.

TABLE 19: CHEMICAL RESISTANCE MATRIX

<table>
<tr><th></th><th>HDPE/EPDM</th><th>HDPE</th><th>LDPE(COPOL)</th><th>EVA(COPOL)</th><th>CSPE</th><th>CR</th><th>EPDM</th><th>CPE</th><th>PVC</th><th>POLYESTER</th><th>ASPHALT</th><th>XR-5</th><th>OTHER MATERIALS</th></tr>
<tr><td>**ACIDS, CARBOXYLIC**</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>*UNSUBSTITUTED (102)*</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Acetic Acid</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Acetic Acid, <30%</td><td>|+</td><td>+|+</td><td>|+</td><td>|+</td><td>|+</td><td>|+</td><td>+|+</td><td>-|</td><td>+|+</td><td>|+</td><td></td><td>|-</td><td>ECB(+|)</td></tr>
<tr><td>Acetic Acid, 30-70%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|-</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Acetic Acid, >70%</td><td>|-</td><td>+|+</td><td>|-</td><td>|+</td><td></td><td>|-</td><td>|-</td><td></td><td>|-</td><td>|+</td><td></td><td></td><td></td></tr>
<tr><td>Acrylic Acid</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Butyric Acid</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Formic Acid</td><td></td><td></td><td></td><td></td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td>|-</td><td></td><td></td><td></td></tr>
<tr><td>Formic Acid, <30%</td><td>|+</td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td></td><td></td><td>|+</td><td></td><td></td><td>|+</td><td></td></tr>
<tr><td>Formic Acid, 30-70%</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td>|-</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Formic Acid, >70%</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td>|-</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lauric Acid</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lauric Acid, 30-70%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Oleic Acid</td><td></td><td>|+</td><td></td><td></td><td>+|</td><td>|-</td><td>|-</td><td>+|+</td><td>|-</td><td>|+</td><td></td><td></td><td>CO(+|),ECO(+|)</td></tr>
<tr><td>Oleic Acid, >70%</td><td>|-</td><td>|+</td><td>|-</td><td>|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Palmitic Acid</td><td></td><td></td><td></td><td></td><td></td><td>|-</td><td>|-</td><td></td><td></td><td>|+</td><td></td><td></td><td></td></tr>
<tr><td>Propionic Acid</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Propionic Acid, 30-70%</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Propionic Acid, >70%</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Stearic Acid</td><td>|-</td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td></td><td></td><td>|+</td><td></td><td></td><td>|+</td><td></td></tr>
</table>

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
ACIDS, CARBOXYLIC (cont.)													
SUBSTITUTED (103)													
Lactic Acid		|+			|+	|+	|+	|+			+|		
Lactic Acid, <30%	|+	|+	|+	|+					|+			|+	
Lactic Acid, 30-70%									|-			|+	
Lactic Acid, >70%									|-				
POLYBASIC (104)													
Adipic Acid		|+										|+	
Maleic Acid		|+											
Maleic Acid, >70%													
Oxalic Acid		|+							|+		+|		
Oxalic Acid, <30%	|+	|+	|+	|+				|+					
L-Tartaric Acid	|+	|+	|+	|+					|+		+|		
AROMATIC (105)													
Benzoic Acid		|+							|+		+|	|-	

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
ACID HALIDES, CARBOXYLIC													
ALIPHATIC (111)													
Acetyl Bromide													
Acetyl Chloride													
AROMATIC AND HETEROCYCLIC (112)													
Benzoyl Chloride													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
ALDEHYDES													
ALIPHATIC AND ALICYCLIC (121)													
Acetaldehyde		|+										|+	
Acrolein													
Butyraldehyde						|-	|-						
Chloroacetaldehyde													
Crotonaldehyde		|+											
Formaldehyde, <37%		|+							|-	|-			
Paraldehyde													
Trichloroacetaldehyde													
AROMATIC AND HETROCYCLIC (122)													
Benzaldehyde	|-	+|+	|-	|-					|-				
Furfural	|+	|+	|-	|-		|-	|-						
Glycidaldehyde													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
AMIDES													
AMIDES (132)													
Dimethylformamide		|+			-|			-|	|-				
Hexamethylphosphoamide													
Urea		|+							|-		+|	|+	

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
AMINES, ALIPHATIC & ALICYCLIC													
PRIMARY (141)													
Butylamine		|+											
alpha,alpha-Dimethylphenethylamine													
Ethanolamine													
Ethylamine		|+											
Isopropylamine													
Methylamine		|+											
n-Propylamine													
SECONDARY (142)													
Diethylamine		|+											
Dimethylamine		|-											
Dipropylamine													
Ethylenimine													
2-Methylaziridine													
Morpholine													
TERTIARY (143)													
Triethanolamine	|+	|+	|-	|-	|+	|+	|+			|-			
Triethanolamine, >70%													
Triethylamine		|+											
Trimethylamine		|+											
POLYAMINE (144)													
Ethylenediamine		|+											

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
AMINES, AROMATIC													
PRIMARY (145)													
Aniline	|+	+|+	|-	|-	-|			-|		|-		|+	
Aniline, >70%									|-				
p-Chloroaniline													
alpha,alpha-Dimethylphenethylamine													
POLYAMINE (147)													
Benzidine													
4,4'-Methylenedianiline													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
ANHYDRIDES, CARBOXYLIC													
ALIPHATIC (161)													
Acetic Anhydride		|+			|+	|+							
Propionic Anhydride		|+											

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
ISOCYANATES													
ISOCYANATES (210)													
Methyl Isocyanate													
Toluene Diisocyanate													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
CYANIDES													
CYANIDES (215)													
Cyanogen Bromide													
Cyanogen Chloride													
Ethyl Cyanide													
Hydrocyanic Acid		|+				|+	|+				+|		
Hydrocyanic Acid, <30%		|+											
Mercuric Cyanide		|+											
Potassium Cyanide		|+									+|	|+	
Potassium Ferricyanide		|+									+|		
Potassium Ferrocyanide		|+									+|		
Silver Cyanide		|+											
Sodium Cyanide		|+									+|		
Sodium Ferriccyanide		|+											
Sodium Ferrocyanide		|+											

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
ESTERS, CARBOXYLIC													
CHLOROFORMATES (221)													
Methyl Chloroformate													
ACETATES (222)													
Amyl Acetate	|-	-|+	|-	|-	|-	|-	|+			|-		|-	
Butyl Acetate		|+								|-			
Ethyl Acetate	|-	-|+	|-	|-	-|-	|-	|+	-|		|+			CO(-|),ECO(-|)
Isoamyl Acetate													
Propyl Acetate													
Propyl Acetate, >70%													
Silver Acetate		|+											
Vinyl Acetate		|-											
HIGHER MONOBASIC (223)													
Ethyl Acrylate													
Ethyl Methacrylate													
Methyl Methacrylate		|+											
Pyrethrins													
POLYBASIC (224)													
Tannic Acid	|+	|+	|+	|+	|+						+|	|+	
Tannic Acid, <30%		|+				|+	|+			|+			
Tannic Acid, 30-70%													
Tannic Acid, >70%													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

<table>
<tr><th></th><th>HDPE/EPDM</th><th>HDPE</th><th>LDPE(COPOL)</th><th>EVA(COPOL)</th><th>CSPE</th><th>CR</th><th>EPDM</th><th>CPE</th><th>PVC</th><th>POLYESTER</th><th>ASPHALT</th><th>XR-5</th><th>OTHER MATERIALS</th></tr>
<tr><td>ESTERS, CARBOXYLIC (cont.)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><i>AROMATIC BENZOATES (225)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Sodium Benzoate</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td></tr>
<tr><td><i>AROMATIC PHTHALATES (226)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bis(2-ethylhexyl) Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>n-Butyl Phthalate</td><td></td><td>|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>CO(-|),ECO(-|)</td></tr>
<tr><td>Butyl Benzyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Diethyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Diheptyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Diisobutyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Diisoctyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Diisodecyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Diisononyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dimethyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dinonyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Di-n-octyl Phthalate</td><td>|-</td><td>|+</td><td>|-</td><td>|-</td><td>|-</td><td>|-</td><td>|-</td><td></td><td></td><td>|+</td><td></td><td></td><td></td></tr>
<tr><td>Diundecyl Phthalate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
ESTERS, OTHER THAN CARBOXYLIC													
SULFONATES (232)													
Ethyl Methanesulfonate													
OTHERS (233)													
Tributyl Phosphate		+|			-|-			-|	-|				IIR(+|)

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

<table>
<tr><th></th><th>HDPE/EPDM</th><th>HDPE</th><th>LDPE(COPOL)</th><th>EVA(COPOL)</th><th>CSPE</th><th>CR</th><th>EPDM</th><th>CPE</th><th>PVC</th><th>POLYESTER</th><th>ASPHALT</th><th>XR-5</th><th>OTHER MATERIALS</th></tr>
<tr><td>ETHERS</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><i>ALIPHATIC (241)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bis(2-chloroethoxy) Methane</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bis(chloromethyl) Ether</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2-Chloroethyl Vinyl Ether</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Chloromethyl Methyl Ether</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dibenzyl Ether</td><td>|-</td><td>|-</td><td>|-</td><td>|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2,2'-Dichloroethyl Ether</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dichloroisopropyl Ether</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Diethylene Glycol Monobutyl Ether</td><td>|-</td><td>|-</td><td>|-</td><td>|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ethyl Ether</td><td>|-</td><td>-|-</td><td>|-</td><td>|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ethylene Glycol Monoethyl</td><td>|-</td><td>|-</td><td>|-</td><td>|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Isopropyl Ether</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><i>AROMATIC (242)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4-Bromophenyl Phenyl Ether</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4-Chlorophenyl Phenyl Ether</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HALOGEN COMPOUNDS													
ALIPHATIC, UNSUBSTITUTED (261)													
Allyl Chloride													
Carbon Tetrachloride	|-	-|-	|-	|-	-|-	|-	|-	-|-	|-	|+			
Carbon Tetrachloride, <30%									+|-				ECB(+|)
Chlorodibromomethane													
Chloroethane													
Chloroform	|-	-|-	|-	|-					|-	|-			
Chloroform, <30%									-|-				ECB(-|)
2-Chlorobutadiene-1,3													
1-Chloropropane													
Dichlorobromomethane													
1,4-Dichloro-2-butene													
Dichloroethane													
Dichloroethylene (all isomers)		|-							|-				
trans-1,2-Dichloroethylene													
1,2-Dichloroethylene													
1,2-Dichloropropane													
Dichloropropane (all isomers)		|-											
Dichloropropane-Dichloropropene		|-											
Dichloropropene(s)		|-											
1,3-Dichloropropene													
Ethylene Dibromide		|+											
Ethylene Dichloride	|-	|-	|-	|-						|-			

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

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<tr><th></th><th>HDPE/EPDM</th><th>HDPE</th><th>LDPE(COPOL)</th><th>EVA(COPOL)</th><th>CSPE</th><th>CR</th><th>EPDM</th><th>CPE</th><th>PVC</th><th>POLYESTER</th><th>ASPHALT</th><th>XR-5</th><th>OTHER MATERIALS</th></tr>
<tr><td>HALOGEN COMPOUNDS (cont.)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><i>ALIPHATIC, UNSUBSTITUTED (261) (cont.)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ethylidene Dichloride</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Freon TF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Freon TMC</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Freon 11</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td><td></td><td></td></tr>
<tr><td>Freon 12</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td><td></td><td></td></tr>
<tr><td>Hexachlorobutadiene</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Hexachloropropene</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Methyl Bromide</td><td></td><td>|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Methyl Chloride</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Methylene Bromide</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Methylene Chloride</td><td></td><td>|-</td><td></td><td></td><td>|-</td><td>|-</td><td>|-</td><td></td><td>|-</td><td>|-</td><td></td><td></td><td></td></tr>
<tr><td>Methyl Iodide</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pentachloroethane</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,1,1,2-Tetrachloroethane</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,1,2,2-Tetrachloroethane</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Tetrachloroethylene</td><td>|-</td><td>-|-</td><td>|-</td><td>|-</td><td></td><td>|-</td><td>|-</td><td></td><td>-|-</td><td>|-</td><td></td><td></td><td>CO(-|),ECO(-|)</td></tr>
<tr><td>Tribromomethane</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,1,2-Trichloroethane</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Trichloroethylene</td><td></td><td>-|-</td><td></td><td></td><td>|-</td><td>|-</td><td>|-</td><td>+|-</td><td>|-</td><td>|-</td><td></td><td></td><td>ECB(+|)</td></tr>
<tr><td>Trichloroethylene, <30%</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Vinyl Chloride</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Vinylidene Chloride</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HALOGEN COMPOUNDS (cont.)													
ALIPHATIC, SUBSTITUTED (262)													
Bis(2-chloroethoxy) Methane													
Bis(chloromethyl) Ether													
Bromoacetone													
Chloroacetaldehyde													
2-Chloroethyl Vinyl Ether													
Chloromethyl Methyl Ether													
3-Chloropropionitrile													
1,2-Dibromo-3-chloropropane													
2,2'-Dichloroethyl Ether													
Dichloroisopropyl Ether													
Diisopropyl Fluorophosphate													
Epichlorohydrin													
Methyl Chloroform													
Trichloroacetaldehyde													
Trichloromethanethiol													
Trifluoroethanol													
AROMATIC, UNSUBSTITUTED (263)													
Benzotrichloride													
Benzyl Chloride	|-	|-	|-	|-									
Benzyl Dichloride													
Bromobenzene	|-	|-	|-	|-									
Chlorobenzene		-|-							|-				

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HALOGEN COMPOUNDS (cont.)													
AROMATIC, UNSUBSTITUTED (263) (cont.)													
Dichlorobenzene		|-											
1,2-Dichlorobenzene													
1,3-Dichlorobenzene													
1,4-Dichlorobenzene													
Hexachlorobenzene													
1,2,4,5-Tetrachlorobenzene													
1,2,4-Trichlorobenzene													
AROMATIC, SUBSTITUTED (264)													
p-Chloroaniline													
p-Chloro-m-cresol													
2-Chlorophenol													
2,4-Dichlorophenol													
2,6-Dichlorophenol													
Pentachlorophenol		|-											
POLYNUCLEAR (265)													
4-Bromophenyl Phenyl Ether													
2-Chloronaphthalene													
Chloronaphthalenes (all isomers)													
4-Chlorophenyl Phenyl Ether													
Polychlorinated Biphenyls (PCBs)		|-											

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HETEROCYCLIC COMPOUNDS													
NITROGEN, PYRIDINES (271)													
alpha-Picoline													
Pyridine		|+							|-				
NITROGEN, QUINOLINES (272)													
Quinoline													
NITROGEN, OTHERS (274)													
Ethylenimine													
2-Methylaziridine													
OXYGEN, EPOXY COMPOUNDS (275)													
2,2'-Bioxirane													
Epichlorohydrin													
Ethylene Oxide										|+			
Glycidaldehyde													
Propylene Oxide		|+											
OXYGEN, FURAN DERIVATIVES (277)													
Furan													
Furfural	|+	|+	|-	|-		|-	|-						
Tetrahydrofuran		-|-							|-	|+			
OXYGEN, OTHERS (278)													
Dihydrosafrole													
1,4-Dioxane		|+							|-				
Isosafrole													
Safrole													

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Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HYDRAZINES													
HYDRAZINES (280)													
1,2-Diethylhydrazine													
1,1-Dimethylhydrazine													
1,2-Dimethylhydrazine													
Hydrazine										|-		|-	
Hydrazine, 30-70%													
Methylhydrazine													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HYDROCARBONS													
ALIPHATIC AND ALICYCLIC (291)													
Butane		|+			|+	|+	|-		|-	|+		|+	
Cyclohexane	|-	-|+	|-	|-	|-	|-	|-	|-	|-	|+			
Decahydronaphthalene		|+							|-				
Ethane												|+	
Gasoline		|+				|-	|-		-|-	|+		|-	
Heptane	|-	-|-	|-	|-					|-				
Hexane	|-	|-	|-	|-	-|			+|	|-	|+		|+	
Isobutylene													
Isooctane		|+			+|			+|	|-	|+			
Isopentane													
Isoprene		|-											
JP-4, Jet Fuel									-|	|+		|+	
Kerosene					-|	|-	|-	-|	-|			|+	CO(+|),ECO(+|)
Methane												|+	
Methylcyclohexane													
Mineral Spirits												|+	
Naphtha, V.M.& P						|-	|-			|+			
Neopentane													
1,3-Pentadiene													
Pentane													
Propane									|-				
Turpentine		-|			-|-	|-	|-	-|				|+	CO(+|),ECO(+|)

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

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TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HYDROCARBONS (cont.)													
AROMATIC (292)													
Benzene	|-	-|-	|-	|-	-|-	|-	|-	-|-	-|-	|+			
p-Chloro-m-cresol													
Creosote													
m-Cresol													
Cresols		|+							|-				
Ethyl Benzene	|-	|-	|-	|-					|-				
Gasoline		|+				|-	|-		-|-	|+		|-	
JP-4, Jet Fuel									-|	|+		|+	
Kerosene					-|	|-	|-	-|	-|			|+	CO(+|),ECO(+|)
(1-Methyl Ethyl) Benzene													
Nitrobenzene	|-	-|+	|-	|-	|-	|-	|+		|-	|-			
Nitrobenzene, 30-70%													
Styrene		|-											
Toluene	|-	-|-	|-	|-	-|-	|-	|-	-|-	-|-	|+		|+	CO(-|),ECO(-|)
Toluene, <30%		+|					-|-						ECB(-|),PVC-CPE(+|), CPE/PE/CPE(-|)
Xylene	|-	-|-	|-	|-	|-	|-	|-	|-	|-	|+			
o-Xylene													
p-Xylene													
Xylene, <30%		+|					+|-	+|	+|-				ECB(+|),PVC-CPE(+|), CPE/PE/CPE(+|)
POLYNUCLEAR (293)													
Napthalene	|-	|-	|-	|-	|-					|+			

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TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
PEROXIDES													
PEROXIDES (300)													
alpha,alpha-Dimethylbenzyl Hydroperoxide													
Hydrogen Peroxide													
Hydrogen Peroxide, <30%		|+			+|			+|	|+				
Hydrogen Peroxide, 30-70%		+|+											
Hydrogen Peroxide, >70%		|+											
Methyl Ethyl Ketone Peroxide													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

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TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HYDROXYL COMPOUNDS													
ALIPHATIC & ALICYCLIC,PRIMARY (311)													
Allyl Alcohol, >70%		|+											
Allyl Alcohol		|+											
Amyl Alcohol		|+							|-	|+			
1-Butanol		|+							|-			|+	
Ethanol	|+	+|+	|-	|+	|+	|+	|+			|+	+|	|+	
Ethanolamine													
Ethanol, <30%									|+				
Ethanol, 30-70%		|+			-|			-|	|-			|+	
Ethanol, >70%					+|			-|+	-|-			|+	IIR(+|)
Furfuryl Alcohol		|+											
1-Hexanol	|+	|+	|+	|+									
Isobutyl Alcohol												|+	
Methanol		|+			+|+	|+	|+			|+		|+	CO(-|),ECO(-|)
Methanol, <30%	|+	+|+	|-	|+			+|		+|				ECB(+|)
Methanol, 30-70%									+|-				
Methanol, >70%								+|	-|-				
n-Octanol													
Propargyl Alcohol													
Propyl Alcohol		|+											
Trifluoroethanol													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HYDROXYL COMPOUNDS (cont.)													
ALIPHATIC & ALICYCLIC,SECONDARY (312)													
Cyclohexanol		|+							|-				
Isopropyl Alcohol	|+	|+	|-	|+		|+				|+			
Lactic Acid		|+			|+	|+	|+	|+			+|		
Lactic Acid, <30%	|+	|+	|+	|+					|+			|+	
Lactic Acid, 30-70%									|-			|+	
Lactic Acid, >70%									|-				
ALIPHATIC & ALICYCLIC,TERTIARY (313)													
Citric Acid		|+			+|+	|+	|+		|+	|+	+|	|+	
Citric Acid, <30%	|+	|+	|+	|+				+|+					
ALIPHATIC & ALICYCLIC,POLYOLS (314)													
1,3-Butylene Glycol		|+											
Ethylene Glycol	|+	+|+	|+	|+	|+	|+	|+	|+	+|	|+	+|	|+	CO(+|),ECO(+|)
Glucose		|+										|+	
Glycerol	|+	|+	|+	|+	|+	|+	|+		|+	|+	+|	|+	
ALIPHATIC & ALICYCLIC,ARYLSUB (315)													
Benzyl Alcohol	|-	|+	|-	|-									
AROMATIC (316)													
p-Chloro-m-cresol													
2-Chlorophenol													
Creosote													
m-Cresol													
Cresols		|+							|-				

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
HYDROXYL COMPOUNDS (cont.)													
AROMATIC (316) (cont.)													
2,4-Dichlorophenol													
2,6-Dichlorophenol													
2,4-Dimethylphenol													
Pentachlorophenol													
Phenol		+|+				|-	|-		|-	|-			
Phenol, <30%	|-	|-	|+	|+	+|			-|	-|				
Phenol, >70%	|-	|+	|-	|-					-|				
Picric Acid		|+	|+		|+	|+	|-:						
Picric Acid, <30%	|-	|+		|+									
Resorcinol	|+	|+	|+	|+									
Salicylic Acid		|+									+|		

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
INORGANIC GASES													
INORGANIC GASES (350)													
Ammonia		|+				|+						|+	
Ammonia, <30%		|+											
Bromine		|-							|-				
Carbon Oxyfluoride													
Chlorine		|-							|-			|+	
Chlorine, <30%		+|				|-	|-						
Cyanogen													
Cyanogen Bromide													
Cyanogen Chloride													
Fluorine		|-											
Hydrocyanic Acid						|+	|+				+|		
Hydrocyanic Acid, <30%		|+											
Hydrogen		|+											
Hydrogen Sulfide		|+				|+	|+		|+	|-	+|		
Nickel Carbonyl													
Nitric Oxide													
Nitrogen Dioxide													
Nitrogen Tetroxide													
Oxygen		|+											
Phosgene		|-											
Phosphine													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
INORGANIC GASES (cont.)													
INORGANIC GASES (350) (cont.)													
Sulfur Dioxide		|+									+|		
Sulfur Dioxide, <30%									|+				
Sulfur Trioxide		|-									+|		

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
INORGANIC ACIDS													
INORGANIC ACIDS (370)													
Antimony Pentachloride		|+											
Arsenic Acid		|+											
Boric Acid		|+			|+	|+	|+		|+	|+	+|	|+	
Chlorosulfonic Acid		|-							|-	|-			
Chlorosulfonic Acid, <30%	|-	|-	|-	|-									
Chromic Acid		|-											
Chromic Acid, <30%	|-	+|+	|-	|-		|-	|-	|+				|+	CO(|+),ECO(|-)
Chromic Acid, 30-70%		|+			|+							|+	
Chromic Acid, >70%	|-	|-	|-	|-									
Fluoboric Acid		|+			|+							|+	
Fluosilicic Acid		|+			|+							|+	
Fluosilicic Acid, 30-70%		|+										|+	
Hydrobromic Acid, 30-70%		|+											
Hydrobromic Acid, >70%		|+											
Hydrochloric Acid		|+											
Hydrochloric Acid, >70%	|+	|+	|-	|-					+|		+|		
Hydrochloric Acid, <30%	|+	|+	|+	|+	+|			+|	+|+	|-	+|	|+	CO(|+),ECO(|+)
Hydrocloric Acid, 30-70%		+|			|+	|+	|-	|+		|-		|+	CO(|-),ECO(|-)
Hydrofluoric Acid, <30%		|+											
Hydrofluoric Acid	+|	|+			|+	-|	-|	-|	-|				IIR(+|)
Hydrofluoric Acid, 30-70%		+|+				|+	|-		|-			|+	
Hydrofluoric Acid, >70%	|+	|+	|-	|-		|-	|-						

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
INORGANIC ACIDS (cont.)													
INORGANIC ACIDS (370)													
Nitric Acid	+|	|+			-|	-|	-|	-|	-|				IIR(+|)
Nitric Acid, <30%	|+	|+	|+	|+	+|			-|	+|-	|-		|-	CO(|+),ECO(|-)
Nitric Acid, 30-70%		+|+			-|	|-	|-	-|	|-	|-			
Nitric Acid, >70%		|-							-|	|-			CO(|-),ECO(|-)
Nitrohydrochoric Acid		|-											
Perchloric Acid													
Perchloric Acid, <30%		|+											
Perchloric Acid, 30-70%		|+											
Phosphoric Acid		|+									+|		
Phosphoric Acid, <30%		|+							|+			|+	CO(|+),ECO(|+)
Phosphoric Acid, 30-70%		|+						|+	|+				
Phosphoric Acid, >70%	|+	+|+	|+	|-		|-	|+						CO(|+),ECO(|-)
Phosphorus Oxychloride													
Phosphorus Trichloride		|-									+|		
Sulfuric Acid													
Sulfuric Acid, <30%	|+	|+	|+	|+				+|	+|+	|+		|+	CO(|+),ECO(|-)
Sulfuric Acid, 30-70%		+|+			|+	|+	|-	|+	|+			|+	
Sulfuric Acid, >70%	|-	|-	|-	|-		|-	|-		|-	|-			CO(|+),ECO(|+)
Sulfur Monochloride													
Sulfurous Acid		|+								|-	+|		
Sulfurous Acid, 30-70%		|+											

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
INORGANIC BASES													
INORGANIC BASES (380)													
Ammonium Hydroxide		|+				|+	|+				+|		
Ammonium Hydroxide, <30%	|+	+|+	|+	|+	-|			-|	|+			|+	
Ammonium Hydroxide, 30-70%												|+	
Ammonium Hydroxide, >70%	|+	|+	|+	|+								|+	
Barium Hydroxide	|+	|+	|+	|+	|+	|+	|+				+|	|+	
Calcium Hydroxide	|+	|+	|+	|+	|+	|+	|+				+|	|+	
Calcium Hydroxide, <30%													
Magnesium Hydroxide		|+			|+	|+	|+				+|		
Potassium Hydroxide		|+			|+			|+		|+		|+	
Potassium Hydroxide, <30%	|+	|+	|+	|+							+|	|+	
Potassium Hydroxide, 30-70%		|+											
Sodium Hydroxide													
Sodium Hydroxide, <30%	|+	|+	|+	|+	+|+	|+	|+	-|	+|	|+	+|		CO(|+),ECO(|+)
Sodium Hydroxide, 30-70%		+|+			+|			+|+		|-		|+	CO(|+),ECO(|+)
Sodium Hydroxide, >70%	|+	|+	|+	|+					|+				

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
KETONES													
ALIPHATIC & ALICYCLIC (391)													
Acetone	|+	|+	|-	|-	+|	|-	|+	-|-	|-	|-			CO(-|),ECO(-|)
Acetone, <30%		+|					+|		+|				ECB(+|)
Bromoacetone													
Cyclohexanone		|+							|-				
Diisobutyl Ketone													
Isophorone													
Methyl Ethyl Ketone	|+	|+	|-	|-		|-	|+		|-	|+			
Methyl Isobutyl Ketone	|+	|+	|-	|-									
ALKYL-ARYL (393)													
Acetophenone		-|											

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
LACTONES													
LACTONES (400)													
2-Methyllactonitrile													
Beta-Propiolactone													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
NITRILES													
ALIPHATIC & ALICYCLIC (431)													
Acetonitrile													
Acrylonitrile		|+											
3-Chloropropionitrile													
Malonitrile													
Methacrylonitrtile													
2-Methyllactonitrile													
AROMATIC (432)													
Benzonitrile													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

<table>
<tr><th></th><th>HDPE/EPDM</th><th>HDPE</th><th>LDPE(COPOL)</th><th>EVA(COPOL)</th><th>CSPE</th><th>CR</th><th>EPDM</th><th>CPE</th><th>PY</th><th>POLYESTER</th><th>ASPHALT</th><th>XR-5</th><th>OTHER MATERIALS</th></tr>
<tr><td>NITRO COMPOUNDS</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><i>UNSUBSTITUTED (441)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nitrobenzene</td><td>|-</td><td>-|+</td><td>|-</td><td>|-</td><td>|-</td><td>|-</td><td>|+</td><td></td><td>|-</td><td>|-</td><td></td><td></td><td></td></tr>
<tr><td>Nitrobenzene, 30-70%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nitroglycerine</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nitromethane</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nitromethane, >70%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nitropropane</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nitrotoluene</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Tetranitromethane</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><i>SUBSTITUTED (442)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Diethyl-p-nitrophenyl Phosphate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Picric Acid</td><td></td><td>|+</td><td>|+</td><td></td><td>|+</td><td>|+</td><td>|-</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Picric Acid, <30%</td><td>|-</td><td>|+</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
ORGANO PHOSPHOROUS COMPOUNDS													
ORGANO PHOSPHOROUS CPDS. (460)													
O,O-Diethyl S-Methyl Dithiophosphate													
Diethyl-p-nitrophenyl Phosphate													
Diisopropyl Fluorophosphate													
Hexaethyltetraphosphate													
Hexamethylphosphoamide													
Tetraethyldithiopyrophosphate													
Tricresyl Phosphate	|-	|+	|-	|-									
Tris(2,3-dibromopropyl) Phosphate													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
ORGANO-METALLIC COMPOUNDS													
ORGANO-METALLIC COMPOUNDS (461)													
Dichlorophenylarsine													
Diethylarsine													
Tetraethyllead													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
QUINONES													
QUINONES (490)													
p-Benzoquinone													
Hydroquinone		|+											
Hydroquinone, <30%													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
SULFUR COMPOUNDS													
THIOLS (501)													
Methylmercaptan													
Thiophenol									|-				
Trichloromethanethiol													
SULFIDES & DISULFIDES (502)													
Carbon Disulfide	|-	|-	|-	|-					|-	|+			
Thiophene		|-											
SULFOXIDES (503)													
Dimethyl Sulfoxide													
SULFONYL CHLORIDES (505)													
Benzenesulfonyl Chloride													
OTHERS (507)													
Dimethyl Sulfate													

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
VINYL HALIDES													
VINYL HALIDES (530)													
Vinyl Chloride													
Vinylidene Chloride		|+											

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

<table>
<tr><th></th><th>HDPE/EPDM</th><th>HDPE</th><th>LDPE(COPOL)</th><th>EVA(COPOL)</th><th>CSPE</th><th>CR</th><th>EPDM</th><th>CPE</th><th>PVC</th><th>POLYESTER</th><th>ASPHALT</th><th>XR-5</th><th>OTHER MATERIALS</th></tr>
<tr><td>INORGANIC SALTS</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><i>INORGANIC SALTS (540)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Aluminum Chloride</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td>|+</td><td></td><td>+|</td><td>|+</td><td></td></tr>
<tr><td>Aluminum Chloride, <30%</td><td>|+</td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Aluminum Fluoride</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td></tr>
<tr><td>Aluminum Potassium Sulfate</td><td></td><td>|+</td><td></td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td>+|</td><td>|+</td><td></td></tr>
<tr><td>Aluminum Sulfate</td><td></td><td>|+</td><td></td><td></td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td></td><td>+|</td><td>|+</td><td></td></tr>
<tr><td>Aluminum Sulfate, <30%</td><td>|+</td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ammonium Chloride</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td>|+</td><td>+|</td><td>|+</td><td></td></tr>
<tr><td>Ammonium Chloride, <30%</td><td>|+</td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ammonium Fluoride</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ammonium Nitrate</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td><td>+|</td><td>|+</td><td></td></tr>
<tr><td>Ammonium Nitrate, <30%</td><td>|+</td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ammonium Phosphate</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td></tr>
<tr><td>Ammonium Phosphate, <30%</td><td>|+</td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Ammonium Sulfate</td><td></td><td>|+</td><td></td><td></td><td>|+</td><td>|+</td><td>|+</td><td></td><td>|+</td><td>|+</td><td>+|</td><td>|+</td><td></td></tr>
<tr><td>Ammonium Sulfide</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Antimony Trichloride</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td></tr>
<tr><td>Antimony Trichloride, >70%</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Barium Chloride, <30%</td><td>|+</td><td>|+</td><td>|+</td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Barium Carbonate</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td></tr>
<tr><td>Barium Chloride</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td><td>+|</td><td>|+</td><td></td></tr>
<tr><td>Barium Chloride, <30%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Barium Sulfate</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td></tr>
</table>

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
INORGANIC SALTS (cont.)													
INORGANIC SALTS (540) (cont.)													
Barium Sulfide		|+										|+	
Barium Sulfide, <30%	|+	|+	|+	|+									
Boric Acid, <30%	|+	|+	|+	|+								|+	
Calcium Bisulfite					|+	|-					+|	|+	
Calcium Carbonate		|+							|+			|+	
Calcium Chlorate		|+											
Calcium Chloride		|+				|+	|+	|+	|+	|+	+|	|+	
Calcium Chloride, <30%	|+	|+	|+	|+									
Calcium Hypochlorite		|+				|-	|+			|+		|+	
Calcium Hypochlorite, <30%	|+	|+	|+	|+	|+								
Calcium Nitrate		|+							|+		+|	|+	
Calcium Sulfate		|+										|+	
Calcium Sulfide, <30%		|-											
Chlorosulfonic Acid		|-							|-	|-			
Chlorosulfonic Acid, <30%	|-	|-	|-	|-									
Cupric Chloride		|+							|+	|+	+|	|+	
Cupric Chloride, <30%	|+	|+	|+	|+									
Cupric Nitrate		|+									+|	|+	
Cupric Sulfate		|+						|+		|+	+|	|+	
Cupric Sulfate, <30%	|+	|+	|+	|+									
Ferric Chloride		|+				|+	|+		|-			|+	
Ferric Chloride, <30%	|+	|+	|+	|-				|+					

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
INORGANIC SALTS (cont.)													
INORGANIC SALTS (540) (cont.)													
Ferric Nitrate		|+											
Ferric Nitrate, <30%	|+	|+	|+	|-									
Ferric Sulfate		|+											
Ferrous Chloride		|+											
Ferrous Sulfate		|+										|+	
Ferrous Sulfate, <30%	|+	|+	|+	|+									
Lead Acetate		|+									+|	|+	
Magnesium Chloride		|+			|+	|+	|+		|+		+|	|+	
Magnesium Chloride, <30%	|+	|+	|+	|+									
Magnesium Nitrate		|+									+|		
Magnesium Sulphate		|+									+|	|+	
Magnesium Sulphate, <30%	|+	|+	|+	|+									
Mercuric Chloride		|+							|+				
Mercuric Nitrate		|+											
Nickel Chloride		|+							|+		+|		
Nickel Nitrate		|+									+|		
Nickel Sulfate		|+									+|	|+	
Nickel Sulfate, <30%	|+	|+	|+	|+									
Potassium Bicarbonate		|+									+|	|+	
Potassium Bisulfate		|+										|+	
Potassium Bisulfide		|+										|+	
Potassium Bromate		|+										|+	

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
INORGANIC SALTS (cont.)													
INORGANIC SALTS (540) (cont.)													
Potassium Bromide		|+										|+	
Potassium Carbonate		|+									+|	|+	
Potassium Chlorate		|+							|+			|+	
Potassium Chloride		|+							|+		+|	|+	
Potassium Chloride, <30%	|+	|+	|+	|+									
Potassium Chromate		|+										|+	
Potassium Dichromate		|+			|+				|+				
Potassium Dichromate, <30%	|+	|+	|+	|+									
Potassium Fluoride		|+										|+	
Potassium Nitrate		|+							|+		+|	|+	
Potassium Perchlorate		|+										|+	
Potassium Permanganate, <30%	|+	|+	|+	|-					|+				
Potassium Persulfate		|+							|+				
Potassium Sulfate		|+							|+		+|		
Potassium Sulfite		|+											
Silver Nitrate		|+									+|		
Sodium Bicarbonate		|+							|+		+|	|+	
Sodium Bicarbonate, <30%	|+	|+	|+	|+									
Sodium Biphosphate		|+										|+	
Sodium Bisulfite		|+							|+			|+	
Sodium Borate		|+			|+	|+	|+	|+				|+	
Sodium Borate, <30%	|+	|+	|+	|+									

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
INORGANIC SALTS (cont.)													
INORGANIC SALTS (540) (cont.)													
Sodium Bromide		|+										|+	
Sodium Carbonate		|+						|+	|+		+|	|+	
Sodium Chlorate		|+							|+			|+	
Sodium Chloride		|+			|+				|+	|+	+|	|+	
Sodium Chloride, <30%	|+	|+	|+	|+									
Sodium Fluoride		|+											
Sodium Hypochlorite, <30%		|+			|+			|+	|+				
Sodium Nitrate		|+							|+		+|	|+	
Sodium Nitrite		|+											
Sodium Sulfate		|+							|+		+|		
Sodium Sulfide		|+							|+		+|		
Stannous Chloride		|+			|+								
Thionyl Chloride		|-											
Zinc Chloride		|+							|+	|+	+|	|+	
Zinc Chloride, <30%													
Zinc Nitrate		|+									+|	|+	
Zinc Nitrate, <30%	|+	|+	|+	|+									
Zinc Oxide		|+											
Zinc Sulfate		|+									+|	|+	

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

<table>
<tr><th></th><th>HDPE/EPDM</th><th>HDPE</th><th>LDPE(COPOL)</th><th>EVA(COPOL)</th><th>CSPE</th><th>CR</th><th>EPDM</th><th>CPE</th><th>PVC</th><th>POLYESTER</th><th>ASPHALT</th><th>XR-5</th><th>OTHER MATERIALS</th></tr>
<tr><td>MISCELLANEOUS</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><i>MISCELLANEOUS (550)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Mercury</td><td></td><td>|+</td><td></td><td></td><td></td><td></td><td></td><td></td><td>|+</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Water</td><td></td><td>+|+</td><td></td><td></td><td>+|+</td><td>+|</td><td>+|</td><td>+|+</td><td>+|+</td><td>|+</td><td>+|</td><td>|+</td><td>IIR(+|),CO(+|),ECO(+|), LDPE(+|)</td></tr>
<tr><td><i>WASTE MATERIALS (999)</i></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Acidic Steel Pickling Waste</td><td></td><td>-|</td><td></td><td></td><td>+|</td><td></td><td>+|</td><td>-|</td><td>-|</td><td></td><td>-|</td><td></td><td>IIR(+|),SC(-|),SA(-|)</td></tr>
<tr><td>Alkaline-Spent Caustic</td><td>+|</td><td></td><td></td><td></td><td>+|</td><td>+|</td><td>+|</td><td>+|</td><td>+|</td><td></td><td></td><td></td><td>IIR(+|)</td></tr>
<tr><td>Base Solutions</td><td></td><td>+|</td><td></td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td></td><td>IIR(+|)</td></tr>
<tr><td>Brine</td><td></td><td>+|</td><td></td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td></td><td>IIR(+|)</td></tr>
<tr><td>Caustic Petroleum Sludge</td><td></td><td>+|</td><td></td><td></td><td>+|</td><td></td><td>+|</td><td>+|</td><td>+|</td><td></td><td>-|</td><td></td><td>IIR(+|),SC(-|),SA(-|)</td></tr>
<tr><td>Domestic Sewage</td><td></td><td>+|</td><td></td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td></td><td>IIR(+|)</td></tr>
<tr><td>Electroplating Sludge</td><td></td><td>-|</td><td></td><td></td><td>+|</td><td></td><td>+|</td><td>-|</td><td>-|</td><td></td><td>-|</td><td></td><td>IIR(+|),SC(-|),SA(-|)</td></tr>
<tr><td>Lead-Low Lead Gasoline Waste</td><td>-|</td><td></td><td></td><td></td><td>-|</td><td>-|</td><td>-|</td><td>-|</td><td>+|</td><td></td><td></td><td></td><td>IIR(-|)</td></tr>
<tr><td>Mild Acids</td><td></td><td>+|</td><td></td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td></td><td>IIR(+|)</td></tr>
<tr><td>Municipal Solid Waste</td><td>+|</td><td></td><td></td><td></td><td>-|</td><td>+|</td><td>+|</td><td>+|</td><td>+|</td><td></td><td></td><td></td><td>IIR(+|)</td></tr>
<tr><td>Oil Refinery Sludge</td><td></td><td>-|</td><td></td><td></td><td>-|</td><td></td><td>-|</td><td>-|</td><td>+|</td><td></td><td>-|</td><td></td><td>IIR(-|),SC(+|),SA(-|)</td></tr>
<tr><td>Oily-Aromatic Oil</td><td>-|</td><td>-|</td><td></td><td></td><td>-|</td><td>-|</td><td>-|</td><td>-|</td><td>-|</td><td></td><td>-|</td><td></td><td>IIR(-|)</td></tr>
<tr><td>Oily-Oil Pond 104</td><td>-|</td><td></td><td></td><td></td><td>-|</td><td>-|</td><td>-|</td><td>-|</td><td>+|</td><td></td><td></td><td></td><td>IIR(-|)</td></tr>
<tr><td>Oily-Weed Oil</td><td>-|</td><td></td><td></td><td></td><td>-|</td><td>-|</td><td>-|</td><td></td><td>-|</td><td></td><td></td><td></td><td>IIR(-|)</td></tr>
<tr><td>Oxidizing Acids</td><td></td><td>-|</td><td></td><td></td><td>-|</td><td>-|</td><td></td><td>-|</td><td>-|</td><td></td><td>-|</td><td></td><td>IIR(-|)</td></tr>
<tr><td>Pesticide - Weed Killer</td><td>+|</td><td></td><td></td><td></td><td>-|</td><td>-|</td><td>-|</td><td>-|</td><td>+|</td><td></td><td></td><td></td><td>IIR(+|)</td></tr>
<tr><td>Petroleum Oil - No Aromatics</td><td></td><td>+|</td><td></td><td></td><td>-|</td><td></td><td></td><td>+|</td><td>-|</td><td></td><td>-|</td><td></td><td>IIR(-|)</td></tr>
<tr><td>Rubber and Plastic Waste</td><td></td><td>+|</td><td></td><td></td><td>+|</td><td></td><td>+|</td><td>+|</td><td>+|</td><td></td><td>+|</td><td></td><td>IIR(+|),SC(+|),SA(+|)</td></tr>
<tr><td>Salt Solutions</td><td></td><td>+|</td><td></td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td>+|</td><td></td><td>+|</td><td></td><td>IIR(+|)</td></tr>
</table>

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codas; see Table 14 and Appendix A.

Source: Arthur D. Little, Inc.

TABLE 19: CHEMICAL RESISTANCE MATRIX (CONTINUED)

	HDPE/EPDM	HDPE	LDPE(COPOL)	EVA(COPOL)	CSPE	CR	EPDM	CPE	PVC	POLYESTER	ASPHALT	XR-5	OTHER MATERIALS
MISCELLANEOUS (cont.)													
WASTE MATERIALS (999) (cont.)													
Simulated Landfill													HAC(+|),SC(-|),SA(+|)
Toxic Pesticide Formulations		+|			-|		-|	-|	+|		-|		IIR(-|),SC(+|),SA(-|)
Toxic Pharmaceutical Waste		+|			-|		-|	-|	+|		-|		IIR(-|),SC(+|),SA(-|)

Note: Liner material abbreviations are defined in Table 1. For explanation of rating codes (e.g., +|+, |-, etc.), see Table 13. Numbers in parentheses are chemical class codes; see Table 14 and Appendix A.
Source: Arthur D. Little, Inc.

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APPENDIX A

CHEMICAL NAMES AND SYNONYMS

NAME:	Acetaldehyde	CASNO:	00075070
SYN:		CLASS:	121
NAME:	Acetic Acid	CASNO:	00064197
SYN:		CLASS:	102
NAME:	Acetic Acid, <30%	CASNO:	00064197
SYN:		CLASS:	102
NAME:	Acetic Acid, 30-70%	CASNO:	00064197
SYN:		CLASS:	102
NAME:	Acetic Acid, >70%	CASNO:	00064197
SYN:		CLASS:	102
NAME:	Acetic Anhydride	CASNO:	00108247
SYN:		CLASS:	161
NAME:	Acetone	CASNO:	00067641
SYN:		CLASS:	391
NAME:	Acetonitrile	CASNO:	00075058
SYN:		CLASS:	431
NAME:	Acetophenone	CASNO:	00098862
SYN:		CLASS:	393
NAME:	Acetyl Bromide	CASNO:	00506967
SYN:		CLASS:	111
NAME:	Acetyl Chloride	CASNO:	00075365
SYN:		CLASS:	111
NAME:	Acidic Steel Pickling Waste	CASNO:	99901000
SYN:		CLASS:	999
NAME:	Acrolein	CASNO:	00107028
SYN:		CLASS:	121
NAME:	Acrylic Acid	CASNO:	00079107
SYN:		CLASS:	102
NAME:	Acrylonitrile	CASNO:	00107131
SYN:		CLASS:	431
NAME:	Adipic Acid	CASNO:	00124049
SYN:		CLASS:	104
NAME:	Alkaline-Spent Caustic	CASNO:	99900200
SYN:		CLASS:	999

CHEMICAL NAMES AND SYNONYMS

NAME:	SYN:	CASNO:	CLASS:
Allyl Alcohol		00107186	311
Allyl Alcohol, >70%		00107186	311
Allyl Chloride	Chloroprene,3-	00107051	261
Aluminum Chloride		07446700	540
Aluminum Chloride, <30%		07446700	540
Aluminum Fluoride		07784181	540
Aluminum Potassium Sulfate	Alums	10043671	540
Aluminum Sulfate		10043013	540
Aluminum Sulfate, <30%		10043013	540
Ammonia		07664417	350
Ammonia, <30%		07664417	350
Ammonium Chloride		12125029	540
Ammonium Chloride, <30%		12125029	540
Ammonium Fluoride		12125018	540
Ammonium Hydroxide		01336216	380
Ammonium Hydroxide, <30%		01336216	380
Ammonium Hydroxide, 30-70%		01336216	380

CHEMICAL NAMES AND SYNONYMS

NAME:	Ammonium Hydroxide, >70%	CASNO:	01336216
SYN:		CLASS:	380
NAME:	Ammonium Nitrate	CASNO:	06484522
SYN:		CLASS:	540
NAME:	Ammonium Nitrate, <30%	CASNO:	06484522
SYN:		CLASS:	540
NAME:	Ammonium Phosphate, <30%	CASNO:	07722701
SYN:		CLASS:	540
NAME:	Ammonium Sulfate	CASNO:	07783202
SYN:		CLASS:	540
NAME:	Ammonium Sulfide	CASNO:	12135761
SYN:		CLASS:	540
NAME:	Amyl Acetate	CASNO:	00628637
SYN:		CLASS:	222
NAME:	Amyl Alcohol	CASNO:	00071410
SYN:		CLASS:	311
NAME:	Aniline	CASNO:	00062533
SYN:	Benzamine	CLASS:	145
NAME:	Aniline, >70%	CASNO:	00062533
SYN:		CLASS:	145
NAME:	Antimony Trichloride, >70%	CASNO:	10025919
SYN:		CLASS:	540
NAME:	Antimony Pentachloride	CASNO:	07647189
SYN:		CLASS:	370
NAME:	Arsenic Acid	CASNO:	07778394
SYN:		CLASS:	370
NAME:	Barium Carbonate	CASNO:	00513779
SYN:		CLASS:	540
NAME:	Barium Chloride, <30%	CASNO:	10361372
SYN:		CLASS:	540
NAME:	Barium Chloride, 30-70%	CASNO:	10361372
SYN:		CLASS:	540
NAME:	Barium Chloride, >70%	CASNO:	10301372
SYN:		CLASS:	540

CHEMICAL NAMES AND SYNONYMS

NAME:	Barium Hydroxide	CASNO:	17194002
SYN:		CLASS:	380
NAME:	Barium Sulfate	CASNO:	07727437
SYN:		CLASS:	540
NAME:	Barium Sulfide	CASNO:	21109955
SYN:		CLASS:	540
NAME:	Barium Sulfide, <30%	CASNO:	21109955
SYN:		CLASS:	540
NAME:	Base Solutions	CASNO:	99901900
SYN:		CLASS:	999
NAME:	Benzaldehyde	CASNO:	00100527
SYN:		CLASS:	122
NAME:	Benzene	CASNO:	00071432
SYN:		CLASS:	292
NAME:	Benzenesulfonyl Chloride	CASNO:	00098099
SYN:		CLASS:	505
NAME:	Benzidine	CASNO:	00092875
SYN:		CLASS:	147
NAME:	Benzoic Acid	CASNO:	00065850
SYN:		CLASS:	105
NAME:	Benzonitrile	CASNO:	00100470
SYN:		CLASS:	432
NAME:	p-Benzoquinone	CASNO:	00106514
SYN:		CLASS:	490
NAME:	Benzotrichloride	CASNO:	00098077
SYN:	Trichloromethyl-benzene	CLASS:	263
NAME:	Benzoyl Chloride	CASNO:	00098884
SYN:		CLASS:	112
NAME:	Benzyl Alcohol	CASNO:	00100516
SYN:		CLASS:	315
NAME:	Benzyl Chloride	CASNO:	00100447
SYN:	Chloromethyl Benzene	CLASS:	263
NAME:	Benzyl Dichloride	CASNO:	00098873
SYN:	Benzal Chloride	CLASS:	263

CHEMICAL NAMES AND SYNONYMS

NAME: 2,2'-Bioxirane CASNO: 01464535
SYN: Erythritol Anhydride CLASS: 275

NAME: Bis(2-chloroethoxy) Methane CASNO: 00111911
SYN: Dichloroethyl Formal CLASS: 241 262

NAME: Bis(chloromethyl) Ether CASNO: 00542881
SYN: Dichloromethyl Ether,sym- CLASS: 262 241

NAME: Bis(2-ethylhexyl) Phthalate CASNO: 00117817
SYN: Di(2-ethylhexyl) Phthalate CLASS: 226

NAME: Boric Acid CASNO: 10043353
SYN: CLASS: 370

NAME: Boric Acid, <30% CASNO: 10043353
SYN: CLASS: 540

NAME: Brine CASNO: 99902200
SYN: CLASS: 999

NAME: Bromine CASNO: 07726956
SYN: CLASS: 350

NAME: Bromoacetone CASNO: 00598312
SYN: CLASS: 391 262

NAME: Bromobenzene CASNO: 00108861
SYN: CLASS: 263

NAME: 4-Bromophenyl Phenyl Ether CASNO: 00101553
SYN: CLASS: 242 265

NAME: Butane CASNO: 00106978
SYN: CLASS: 291

NAME: 1-Butanol CASNO: 00071363
SYN: Butyl Alcohol CLASS: 311

NAME: n-Butyl Phthalate CASNO: 00084742
SYN: Dibutyl Phthalate CLASS: 226

NAME: Butyl Acetate CASNO: 00123864
SYN: CLASS: 222

NAME: Butylamine CASNO: 00109739
SYN: CLASS: 141

NAME: Butyl Benzyl Phthalate CASNO: 00085687
SYN: CLASS: 226

CHEMICAL NAMES AND SYNONYMS

NAME: 1,3-Butylene Glycol CASNO: 00107880
SYN: Butanediol,1,3 CLASS: 314

NAME: Butyraldehyde CASNO: 00123728
SYN: CLASS: 121

NAME: Butyric Acid CASNO: 00107926
SYN: CLASS: 102

NAME: Calcium Bisulfite CASNO: 13780035
SYN: CLASS: 540

NAME: Calcium Carbonate CASNO: 00471341
SYN: CLASS: 540

NAME: Calcium Chlorate CASNO: 10137743
SYN: CLASS: 540

NAME: Calcium Chloride CASNO: 10043524
SYN: CLASS: 540

NAME: Calcium Chloride, <30% CASNO: 10043524
SYN: CLASS: 540

NAME: Calcium Hydroxide CASNO: 01305620
SYN: CLASS: 380

NAME: Calcium Hydroxide, <30% CASNO: 01305620
SYN: CLASS: 380

NAME: Calcium Hypochlorite CASNO: 07778543
SYN: CLASS: 540

NAME: Calcium Hypochlorite, <30% CASNO: 07778543
SYN: CLASS: 540

NAME: Calcium Nitrate CASNO: 10124375
SYN: CLASS: 540

NAME: Calcium Sulfate CASNO: 07778189
SYN: CLASS: 540

NAME: Calcium Sulfide, <30% CASNO: 20548543
SYN: CLASS: 540

NAME: Carbon Disulfide CASNO: 00075150
SYN: Carbon Bisulfide CLASS: 502

NAME: Carbon Oxyfluoride CASNO: 00353504
SYN: CLASS: 350

CHEMICAL NAMES AND SYNONYMS

NAME: Carbon Tetrachloride CASNO: 00056235
SYN: Tetrachloromethane CLASS: 261

NAME: Caustic Petroleum Sludge CASNO: 99900900
SYN: CLASS: 999

NAME: Chlorine CASNO: 07782505
SYN: CLASS: 350

NAME: Chlorine, <30% CASNO: 07782505
SYN: CLASS: 350

NAME: Chloroacetaldehyde CASNO: 00107200
SYN: CLASS: 121 262

NAME: p-Chloroaniline CASNO: 00106478
SYN: Chlorobenzamine,4 CLASS: 145 264

NAME: Chlorobenzene CASNO: 00108907
SYN: CLASS: 263

NAME: p-Chloro-m-cresol CASNO: 00059507
SYN: CLASS: 292 316 264

NAME: Chlorodibromomethane CASNO: 00124481
SYN: CLASS: 261

NAME: Chloroethane CASNO: 00075003
SYN: CLASS: 261

NAME: 2-Chloroethyl Vinyl Ether CASNO: 00110758
SYN: CLASS: 241 262

NAME: Chloroform CASNO: 00067663
SYN: Trichloromethane CLASS: 261

NAME: Chloromethyl Methyl Ether CASNO: 00107302
SYN: CLASS: 241 262

NAME: 2-Chloronaphthalene CASNO: 00091587
SYN: CLASS: 265

NAME: Chloronaphthalenes (all isomers) CASNO: 25586430
SYN: CLASS: 265

NAME: 2-Chlorophenol CASNO: 00095578
SYN: CLASS: 316 264

NAME: 4-Chlorophenyl Phenyl Ether CASNO: 07005723
SYN: CLASS: 265 242

CHEMICAL NAMES AND SYNONYMS

NAME:	2-Chlorobutadiene-1,3	CASNO:	00126998
SYN:	Chloroprene	CLASS:	261
NAME:	1-Chloropropane	CASNO:	00540545
SYN:	Propyl Chloride	CLASS:	261
NAME:	3-Chloropropionitrile	CASNO:	00542767
SYN:		CLASS:	262 431
NAME:	Chlorosulfonic Acid	CASNO:	07790945
SYN:		CLASS:	370 540
NAME:	Chlorosulfonic Acid, <30%	CASNO:	07790945
SYN:		CLASS:	370 540
NAME:	Chromic Acid	CASNO:	11115745
SYN:		CLASS:	370
NAME:	Chromic Acid, <30%	CASNO:	11115745
SYN:		CLASS:	370
NAME:	Chromic Acid, 30-70%	CASNO:	11115745
SYN:		CLASS:	370
NAME:	Chromic Acid, >70%	CASNO:	11115745
SYN:		CLASS:	370
NAME:	Citric Acid	CASNO:	00077929
SYN:		CLASS:	313
NAME:	Citric Acid, <30%	CASNO:	00077929
SYN:		CLASS:	313
NAME:	Creosote	CASNO:	08001589
SYN:		CLASS:	292 316
NAME:	m-Cresol	CASNO:	00108394
SYN:		CLASS:	292 316
NAME:	Cresols	CASNO:	01319773
SYN:		CLASS:	292 316
NAME:	Crotonaldehyde	CASNO:	04170303
SYN:	Butenal,trans-2	CLASS:	121
NAME:	Cupric Chloride	CASNO:	07447394
SYN:	Copper Chloride	CLASS:	540
NAME:	Cupric Chloride, <30%	CASNO:	07447394
SYN:		CLASS:	540

CHEMICAL NAMES AND SYNONYMS

NAME: Cupric Nitrate CASNO: 03251238
SYN: Copper Nitrate CLASS: 540

NAME: Cupric Sulfate CASNO: 07758987
SYN: Copper Sulphate CLASS: 540

NAME: Cupric Sulfate, <30% CASNO: 07758987
SYN: CLASS: 540

NAME: Cyanogen CASNO: 00460195
SYN: CLASS: 350

NAME: Cyanogen Bromide CASNO: 00506683
SYN: Bromine Cyanide CLASS: 215 350

NAME: Cyanogen Chloride CASNO: 00506774
SYN: Chlorine Cyanide CLASS: 215 350

NAME: Cyclohexane CASNO: 00110827
SYN: CLASS: 291

NAME: Cyclohexanol CASNO: 00108930
SYN: CLASS: 312

NAME: Cyclohexanone CASNO: 00108941
SYN: CLASS: 391

NAME: Decahydronaphthalene CASNO: 00091178
SYN: Decalin CLASS: 291

NAME: Dibenzyl Ether CASNO: 00103504
SYN: Benzyl Ether CLASS: 241

NAME: 1,2-Dibromo-3-chloropropane CASNO: 00096128
SYN: CLASS: 262

NAME: Dichlorobenzene CASNO: 25321226
SYN: CLASS: 263

NAME: 1,2-Dichlorobenzene CASNO: 00095501
SYN: CLASS: 263

NAME: 1,3-Dichlorobenzene CASNO: 00541731
SYN: CLASS: 263

NAME: 1,4-Dichlorobenzene CASNO: 00106467
SYN: CLASS: 263

NAME: Dichlorobromomethane CASNO: 00075274
SYN: CLASS: 261

CHEMICAL NAMES AND SYNONYMS

NAME: 1,4-Dichloro-2-butene CASNO: 00110576
SYN: CLASS: 261

NAME: Dichloroethane CASNO: 01300216
SYN: CLASS: 261

NAME: Dichloroethylene (all isomers) CASNO: 25323302
SYN: Dichloroethene CLASS: 261

NAME: trans-1,2-Dichloroethylene CASNO: 00156605
SYN: CLASS: 261

NAME: 1,2-Dichloroethylene CASNO: 00540590
SYN: CLASS: 261

NAME: 2,2'-Dichloroethyl Ether CASNO: 00111444
SYN: CLASS: 241 262

NAME: Dichloroisopropyl Ether CASNO: 00108601
SYN: Bis(2-chloroisopropyl) Ether CLASS: 241 262

NAME: 2,4-Dichlorophenol CASNO: 00120832
SYN: CLASS: 264 316

NAME: 2,6-Dichlorophenol CASNO: 00087650
SYN: CLASS: 264 316

NAME: Dichlorophenylarsine CASNO: 00696286
SYN: Phenyl Dichloroarsine CLASS: 461

NAME: 1,2-Dichloropropane CASNO: 00078875
SYN: Propylene Dichloride CLASS: 261

NAME: Dichloropropane (all isomers) CASNO: 26638197
SYN: CLASS: 261

NAME: Dichloropropane-Dichloropropene CASNO: 08003198
SYN: CLASS: 261

NAME: Dichloropropene(s) CASNO: 26952238
SYN: CLASS: 261

NAME: 1,3-Dichloropropene CASNO: 00542756
SYN: CLASS: 261

NAME: Diethylamine CASNO: 00109897
SYN: CLASS: 142

NAME: Diethylarsine CASNO: 00692422
SYN: CLASS: 461

CHEMICAL NAMES AND SYNONYMS

NAME:	Diethylene Glycol Monobutyl Ether	CASNO:	00112345
SYN:	Butyl Carbitol	CLASS:	241
NAME:	1,2-Diethylhydrazine	CASNO:	01615801
SYN:		CLASS:	280
NAME:	O,O-Diethyl S-Methyl Dithiophosphate	CASNO:	03288582
SYN:		CLASS:	460
NAME:	Diethyl-p-nitrophenyl Phosphate	CASNO:	00311455
SYN:		CLASS:	460 442
NAME:	Diethyl Phthalate	CASNO:	00084662
SYN:		CLASS:	226
NAME:	Diheptyl Phthalate	CASNO:	03648213
SYN:		CLASS:	226
NAME:	Dihydrosafrole	CASNO:	00094586
SYN:		CLASS:	278
NAME:	Diisobutyl Ketone	CASNO:	00108838
SYN:	Dimethyl-4-heptanone,2,6	CLASS:	391
NAME:	Diisobutyl Phthalate	CASNO:	00084695
SYN:		CLASS:	226
NAME:	Diisoctyl Phthalate	CASNO:	27554263
SYN:		CLASS:	226
NAME:	Diisodecyl Phthalate	CASNO:	26761400
SYN:		CLASS:	226
NAME:	Diisononyl Phthalate	CASNO:	28553120
SYN:		CLASS:	226
NAME:	Diisopropyl Fluorophosphate	CASNO:	00055914
SYN:		CLASS:	460 262
NAME:	Dimethylamine	CASNO:	00124403
SYN:		CLASS:	142
NAME:	alpha,alpha-Dimethylbenzyl Hydroperoxide	CASNO:	00080159
SYN:		CLASS:	300
NAME:	Dimethylformamide	CASNO:	00068122
SYN:		CLASS:	132
NAME:	1,1-Dimethylhydrazine	CASNO:	00057147
SYN:	Dimethylhydrazine,unsym-	CLASS:	280

CHEMICAL NAMES AND SYNONYMS

NAME: 1,2-Dimethylhydrazine CASNO: 00540738
SYN: Dimethylhydrazine,sym- CLASS: 280

NAME: alpha,alpha-Dimethylphenethylamine CASNO: 00122098
SYN: CLASS: 141 145

NAME: 2,4-Dimethylphenol CASNO: 00105679
SYN: CLASS: 316

NAME: Dimethyl Phthalate CASNO: 00131113
SYN: CLASS: 226

NAME: Dimethyl Sulfate CASNO: 00077781
SYN: CLASS: 507

NAME: Dimethyl Sulfoxide CASNO: 00067685
SYN: CLASS: 503

NAME: Dinonyl Phthalate CASNO: 00084764
SYN: CLASS: 226

NAME: Di-n-octyl Phthalate CASNO: 00117840
SYN: CLASS: 226

NAME: 1,4-Dioxane CASNO: 00123911
SYN: Diethylene Dioxide,1,4 CLASS: 278

NAME: Dipropylamine CASNO: 00142847
SYN: CLASS: 142

NAME: Diundecyl Phthalate CASNO: 03648202
SYN: CLASS: 226

NAME: Domestic Sewage CASNO: 99901700
SYN: CLASS: 999

NAME: Electroplating Sludge CASNO: 99901100
SYN: CLASS: 999

NAME: Epichlorohydrin CASNO: 00106898
SYN: Chloro-2,3-epoxy Propane,1 CLASS: 275 262

NAME: Ethane CASNO: 00074840
SYN: CLASS: 291

NAME: Ethanol CASNO: 00064175
SYN: Ethyl alcohol CLASS: 311

NAME: Ethanolamine CASNO: 00141435
SYN: Aminoethanol,2 CLASS: 141 311

CHEMICAL NAMES AND SYNONYMS

NAME:	Ethanol, <30%	CASNO:	00064175
SYN:		CLASS:	311
NAME:	Ethanol, 30-70%	CASNO:	00064175
SYN:		CLASS:	311
NAME:	Ethanol, >70%	CASNO:	00064175
SYN:		CLASS:	311
NAME:	Ethyl Acetate	CASNO:	00141786
SYN:		CLASS:	222
NAME:	Ethyl Acrylate	CASNO:	00140885
SYN:		CLASS:	223
NAME:	Ethyl Ether	CASNO:	00060297
SYN:	Diethyl Ether	CLASS:	241
NAME:	Ethylamine	CASNO:	00075047
SYN:	Monoethylamine	CLASS:	141
NAME:	Ethyl Benzene	CASNO:	00100414
SYN:		CLASS:	292
NAME:	Ethyl Cyanide	CASNO:	00107120
SYN:		CLASS:	215
NAME:	Ethylene Glycol Monoethyl Ether	CASNO:	00110805
SYN:	Ethoxyethanol,2	CLASS:	241
NAME:	Ethylenediamine	CASNO:	00107153
SYN:	Diaminoethane,1,2	CLASS:	144
NAME:	Ethylene Dibromide	CASNO:	00106934
SYN:	Dibromoethane,1,2	CLASS:	261
NAME:	Ethylene Dichloride	CASNO:	00107062
SYN:	Dichloroethane,1,2	CLASS:	261
NAME:	Ethylene Glycol	CASNO:	00107211
SYN:		CLASS:	314
NAME:	Ethylene Oxide	CASNO:	00075218
SYN:	Oxirane	CLASS:	275
NAME:	Ethylenimine	CASNO:	00151564
SYN:	Aziridine	CLASS:	274 142
NAME:	Ethylidene Dichloride	CASNO:	00075343
SYN:	Dichloroethane,1,1	CLASS:	261

CHEMICAL NAMES AND SYNONYMS

NAME:	Ethyl Methacrylate	CASNO:	00097632
SYN:		CLASS:	223
NAME:	Ethyl Methanesulfonate	CASNO:	00062500
SYN:		CLASS:	232
NAME:	Ferric Chloride	CASNO:	07705080
SYN:		CLASS:	540
NAME:	Ferric Chloride, <30%	CASNO:	07705080
SYN:		CLASS:	540
NAME:	Ferric Nitrate	CASNO:	10421484
SYN:		CLASS:	540
NAME:	Ferric Nitrate, <30%	CASNO:	10421484
SYN:		CLASS:	540
NAME:	Ferric Sulfate	CASNO:	10028225
SYN:		CLASS:	540
NAME:	Ferrous Chloride	CASNO:	07758943
SYN:		CLASS:	540
NAME:	Ferrous Sulfate	CASNO:	07720787
SYN:		CLASS:	540
NAME:	Ferrous Sulfate, <30%	CASNO:	07720787
SYN:		CLASS:	540
NAME:	Fluoboric Acid	CASNO:	16872110
SYN:		CLASS:	370
NAME:	Fluorine	CASNO:	07782414
SYN:		CLASS:	350
NAME:	Fluosilicic Acid	CASNO:	16961834
SYN:		CLASS:	370
NAME:	Fluosilicic Acid, 30-70%	CASNO:	16961834
SYN:		CLASS:	370
NAME:	Formaldehyde, <37%	CASNO:	00050000
SYN:	Formalin	CLASS:	121
NAME:	Formic Acid	CASNO:	00064186
SYN:	Methanoic Acid	CLASS:	102
NAME:	Formic Acid, <30%	CASNO:	00064186
SYN:		CLASS:	102

CHEMICAL NAMES AND SYNONYMS

NAME: Formic Acid, 30-70% CASNO: 00064186
SYN: CLASS: 102

NAME: Formic Acid, >70% CASNO: 00064186
SYN: CLASS: 102

NAME: Freon TF CASNO: 00076131
SYN: Trichlorotrifluoroethane CLASS: 261

NAME: Freon TMC CASNO: 57762319
SYN: Trichloro-1,2,2-trifluoroethane,(1,1,2) CLASS: 261

NAME: Freon 11 CASNO: 00075694
SYN: Trichloromonofluoromethane CLASS: 261

NAME: Freon 12 CASNO: 00075718
SYN: Dichlorodifluoromethane CLASS: 261

NAME: Furan CASNO: 00110009
SYN: Furfuran CLASS: 277

NAME: Furfural CASNO: 00098011
SYN: CLASS: 277 122

NAME: Furfuryl Alcohol CASNO: 00098000
SYN: CLASS: 311

NAME: Gasoline CASNO: 08006619
SYN: CLASS: 291 292

NAME: Glucose CASNO: 00050997
SYN: CLASS: 314

NAME: Glycerol CASNO: 00056815
SYN: Propanetriol,1,2,3 CLASS: 314

NAME: Glycidaldehyde CASNO: 00765344
SYN: CLASS: 275 122

NAME: Heptane CASNO: 00142825
SYN: CLASS: 291

NAME: Hexachlorobenzene CASNO: 00118741
SYN: CLASS: 263

NAME: Hexachlorobutadiene CASNO: 00087683
SYN: CLASS: 261

NAME: Hexachloropropene CASNO: 01888717
SYN: CLASS: 261

CHEMICAL NAMES AND SYNONYMS

NAME:	Hexaethyltetraphosphate	CASNO:	00757584
SYN:		CLASS:	460
NAME:	Hexamethylphosphoamide	CASNO:	00680319
SYN:		CLASS:	132 460
NAME:	Hexane	CASNO:	00110543
SYN:		CLASS:	291
NAME:	1-Hexanol	CASNO:	00111273
SYN:		CLASS:	311
NAME:	Hydrazine	CASNO:	00302012
SYN:	Diamine	CLASS:	280
NAME:	Hydrazine, 30-70%	CASNO:	00302012
SYN:		CLASS:	280
NAME:	Hydrobromic Acid, 30-70%	CASNO:	10035106
SYN:		CLASS:	370
NAME:	Hydrobromic Acid, >70%	CASNO:	10035106
SYN:		CLASS:	370
NAME:	Hydrochloric Acid	CASNO:	07647010
SYN:		CLASS:	370
NAME:	Hydrochloric Acid, <30%	CASNO:	07647010
SYN:		CLASS:	370
NAME:	Hydrocloric Acid, 30-70%	CASNO:	07647010
SYN:		CLASS:	370
NAME:	Hydrochloric Acid, >70%	CASNO:	07647010
SYN:		CLASS:	370
NAME:	Hydrocyanic Acid	CASNO:	00074908
SYN:		CLASS:	215 350
NAME:	Hydrocyanic Acid, <30%	CASNO:	00074908
SYN:		CLASS:	215 350
NAME:	Hydrofluoric Acid	CASNO:	07664393
SYN:		CLASS:	370
NAME:	Hydrofluoric Acid, <30%	CASNO:	07664393
SYN:		CLASS:	370
NAME:	Hydrofluoric Acid, 30-70%	CASNO:	07664393
SYN:		CLASS:	370

CHEMICAL NAMES AND SYNONYMS

NAME:	SYN:	CASNO:	CLASS:
Hydrofluoric Acid, >70%		07664393	370
Hydrogen		01333740	350
Hydrogen Peroxide		07722841	300
Hydrogen Peroxide, <30%		07722841	300
Hydrogen Peroxide, 30-70%		07722841	300
Hydrogen Peroxide, >70%		07722841	300
Hydrogen Sulfide		07783064	350
Hydroquinone		00123319	490
Hydroquinone, <30%		00123319	490
Isoamyl Acetate		00123922	222
Isobutyl Alcohol		00078831	311
Isobutylene	Isobutene	00115117	291
Isooctane		26635643	291
Isopentane	2-Methylbutane, Ethyldimethylmethane	00078784	291
Isophorone		00078591	391
Isoprene		00078795	291
Isopropyl Alcohol		00067630	312

CHEMICAL NAMES AND SYNONYMS

NAME: Isopropylamine CASNO: 00075310
SYN: CLASS: 141

NAME: Isopropyl Ether CASNO: 00108203
SYN: Diisopropyl Ether CLASS: 241

NAME: Isosafrole CASNO: 00120581
SYN: CLASS: 278

NAME: JP-4, Jet Fuel CASNO: 99901291
SYN: CLASS: 291 292

NAME: Kerosene CASNO: 08008206
SYN: CLASS: 291 292

NAME: Lactic Acid CASNO: 00079334
SYN: CLASS: 103 312

NAME: Lactic Acid, <30% CASNO: 00079334
SYN: CLASS: 103 312

NAME: Lactic Acid, 30-70% CASNO: 00079334
SYN: CLASS: 103 312

NAME: Lactic Acid, >70% CASNO: 00079334
SYN: CLASS: 103 312

NAME: Lauric Acid CASNO: 00143077
SYN: CLASS: 102

NAME: Lauric Acid, 30-70% CASNO: 00143077
SYN: CLASS: 102

NAME: Lead Acetate CASNO: 00301042
SYN: CLASS: 540

NAME: Lead-Low Lead Gasoline Washwater CASNO: 99900300
SYN: CLASS: 999

NAME: Magnesium Chloride CASNO: 07786303
SYN: CLASS: 540

NAME: Magnesium Chloride, <30% CASNO: 07786303
SYN: CLASS: 540

NAME: Magnesium Hydroxide CASNO: 01309428
SYN: CLASS: 380

NAME: Magnesium Nitrate CASNO: 10377603
SYN: CLASS: 540

CHEMICAL NAMES AND SYNONYMS

NAME: Magnesium Sulphate
SYN:
CASNO: 07487889
CLASS: 540

NAME: Magnesium Sulphate, <30%
SYN:
CASNO: 07487889
CLASS: 540

NAME: Maleic Acid
SYN:
CASNO: 00110167
CLASS: 104

NAME: Maleic Acid, >70%
SYN:
CASNO: 00110167
CLASS: 104

NAME: Malonitrile
SYN: Propane Dinitrile
CASNO: 00109773
CLASS: 431

NAME: Mercuric Chloride
SYN:
CASNO: 07487947
CLASS: 540

NAME: Mercuric Cyanide
SYN:
CASNO: 00592041
CLASS: 215

NAME: Mercuric Nitrate
SYN:
CASNO: 10045940
CLASS: 540

NAME: Mercury
SYN:
CASNO: 07439976
CLASS: 550

NAME: Methacrylonitrtile
SYN:
CASNO: 00126987
CLASS: 431

NAME: Methane
SYN:
CASNO: 00074828
CLASS: 291

NAME: Methanol
SYN: Methyl Alcohol
CASNO: 00067561
CLASS: 311

NAME: Methanol, <30%
SYN:
CASNO: 00067561
CLASS: 311

NAME: Methanol, 30-70%
SYN:
CASNO: 00067561
CLASS: 311

NAME: Methanol, >70%
SYN:
CASNO: 00067561
CLASS: 311

NAME: (1-Methyl Ethyl) Benzene
SYN: Cumene
CASNO: 00098828
CLASS: 292

NAME: Methylamine
SYN: Monomethylamine
CASNO: 00074895
CLASS: 141

CHEMICAL NAMES AND SYNONYMS

NAME:	2-Methylaziridine	CASNO:	00075558
SYN:	Propylenimine,1,2	CLASS:	274 142
NAME:	Methyl Bromide	CASNO:	00074839
SYN:	Bromomethane	CLASS:	261
NAME:	Methyl Chloride	CASNO:	00074873
SYN:	Chloromethane	CLASS:	261
NAME:	Methyl Chloroform	CASNO:	00071556
SYN:	Trichloroethane,1,1,1	CLASS:	262
NAME:	Methyl Chloroformate	CASNO:	00079221
SYN:		CLASS:	221
NAME:	Methylcyclohexane	CASNO:	00108872
SYN:		CLASS:	291
NAME:	Methylene Bromide	CASNO:	00074953
SYN:	Dibromomethane	CLASS:	261
NAME:	Methylene Chloride	CASNO:	00075092
SYN:	Dichloromethane	CLASS:	261
NAME:	4,4'-Methylenedianiline	CASNO:	00101779
SYN:		CLASS:	147
NAME:	Methyl Ethyl Ketone	CASNO:	00078933
SYN:	Butanone,2	CLASS:	391
NAME:	Methyl Ethyl Ketone Peroxide	CASNO:	01338234
SYN:		CLASS:	300
NAME:	Methylhydrazine	CASNO:	00060344
SYN:		CLASS:	280
NAME:	Methyl Iodide	CASNO:	00074884
SYN:		CLASS:	261
NAME:	Methyl Isobutyl Ketone	CASNO:	00108101
SYN:		CLASS:	391
NAME:	Methyl Isocyanate	CASNO:	00624839
SYN:		CLASS:	210
NAME:	2-Methyllactonitrile	CASNO:	00075865
SYN:	Acetone Cyanohydrin	CLASS:	431 400
NAME:	Methylmercaptan	CASNO:	00074931
SYN:	Methanethiol	CLASS:	501

CHEMICAL NAMES AND SYNONYMS

NAME:	Methyl Methacrylate	CASNO:	00080626
SYN:		CLASS:	223
NAME:	Mild Acids	CASNO:	99902000
SYN:		CLASS:	999
NAME:	Mineral Spirits	CASNO:	08052413
SYN:		CLASS:	291
NAME:	Morpholine	CASNO:	00110918
SYN:		CLASS:	142
NAME:	Municipal Solid Waste	CASNO:	99900100
SYN:		CLASS:	999
NAME:	Naphtha, V.M.& P	CASNO:	08032324
SYN:	Ligroine	CLASS:	291
NAME:	Napthalene	CASNO:	00091203
SYN:		CLASS:	293
NAME:	Neopentane	CASNO:	00463821
SYN:		CLASS:	291
NAME:	Nickel Chloride	CASNO:	07718549
SYN:		CLASS:	540
NAME:	Nickel Nitrate	CASNO:	13138459
SYN:		CLASS:	540
NAME:	Nickel Sulfate	CASNO:	07786814
SYN:		CLASS:	540
NAME:	Nickel Sulfate, <30%	CASNO:	07786814
SYN:		CLASS:	540
NAME:	Nickel Carbonyl	CASNO:	13463393
SYN:		CLASS:	350
NAME:	Nitric Acid	CASNO:	07697372
SYN:		CLASS:	370
NAME:	Nitric Acid, <30%	CASNO:	07697372
SYN:		CLASS:	370
NAME:	Nitric Acid, 30-70%	CASNO:	07697372
SYN:		CLASS:	370
NAME:	Nitric Acid, >70%	CASNO:	07697372
SYN:		CLASS:	370

CHEMICAL NAMES AND SYNONYMS

NAME: Nitric Oxide
SYN:
CASNO: 10102439
CLASS: 350

NAME: Nitrobenzene
SYN:
CASNO: 00098953
CLASS: 441 292

NAME: Nitrobenzene, 30-70%
SYN:
CASNO: 00098953
CLASS: 441 292

NAME: Nitrogen Dioxide
SYN:
CASNO: 10102440
CLASS: 350

NAME: Nitrogen Tetroxide
SYN:
CASNO: 10544726
CLASS: 350

NAME: Nitroglycerine
SYN:
CASNO: 00055630
CLASS: 441

NAME: Nitrohydrochoric Acid
SYN: Aqua Regia
CASNO: 08007565
CLASS: 370

NAME: Nitromethane
SYN:
CASNO: 00075525
CLASS: 441

NAME: Nitromethane, >70%
SYN:
CASNO: 00075525
CLASS: 441

NAME: Nitropropane
SYN:
CASNO: 25322014
CLASS: 441

NAME: Nitrotoluene
SYN:
CASNO: 01321126
CLASS: 441

NAME: n-Octanol
SYN:
CASNO: 29063283
CLASS: 311

NAME: Oil Refinery Sludge
SYN:
CASNO: 99901300
CLASS: 999

NAME: Oily-Aromatic Oil
SYN:
CASNO: 99900400
CLASS: 999

NAME: Oily-Oil Pond 104
SYN:
CASNO: 99900500
CLASS: 999

NAME: Oily-Weed Oil
SYN:
CASNO: 99900600
CLASS: 999

NAME: Oleic Acid
SYN:
CASNO: 00112801
CLASS: 102

CHEMICAL NAMES AND SYNONYMS

NAME: Oleic Acid, >70% CASNO: 00112801
SYN: CLASS: 102

NAME: Oxalic Acid CASNO: 00144627
SYN: CLASS: 104

NAME: Oxalic Acid, <30% CASNO: 00144627
SYN: CLASS: 104

NAME: Oxidizing Acids CASNO: 99902100
SYN: CLASS: 999

NAME: Oxygen CASNO: 07782447
SYN: CLASS: 350

NAME: Palmitic Acid CASNO: 00057103
SYN: CLASS: 102

NAME: Paraldehyde CASNO: 00123637
SYN: CLASS: 121

NAME: Pentachloroethane CASNO: 00076017
SYN: CLASS: 261

NAME: Pentachlorophenol CASNO: 00087865
SYN: CLASS: 264 316

NAME: 1,3-Pentadiene CASNO: 00504609
SYN: Methylbutadiene,1 CLASS: 291

NAME: Pentane CASNO: 00109660
SYN: CLASS: 291

NAME: Perchloric Acid CASNO: 07601903
SYN: CLASS: 370

NAME: Perchloric Acid, <30% CASNO: 07601903
SYN: CLASS: 370

NAME: Perchloric Acid, 30-70% CASNO: 07601903
SYN: CLASS: 370

NAME: Pesticide - Weed Killer CASNO: 99900700
SYN: CLASS: 999

NAME: Petroleum Oil - No Aromatics CASNO: 99901600
SYN: CLASS: 999

NAME: Phenol CASNO: 00108952
SYN: Carbolic Acid CLASS: 316

CHEMICAL NAMES AND SYNONYMS

NAME:	Phenol, <30%	CASNO:	00108952
SYN:		CLASS:	316
NAME:	Phenol, >70%	CASNO:	00108952
SYN:		CLASS:	316
NAME:	Phosgene	CASNO:	00075445
SYN:	Carbonyl Chloride	CLASS:	350
NAME:	Phosphine	CASNO:	07803512
SYN:	Hydrogen Phosphide	CLASS:	350
NAME:	Phosphoric Acid	CASNO:	07664382
SYN:		CLASS:	370
NAME:	Phosphoric Acid, <30%	CASNO:	07664382
SYN:		CLASS:	370
NAME:	Phosphoric Acid, 30-70%	CASNO:	07664382
SYN:		CLASS:	370
NAME:	Phosphoric Acid, >70%	CASNO:	07664382
SYN:		CLASS:	370
NAME:	Phosphorus Oxychloride	CASNO:	10025873
SYN:		CLASS:	370
NAME:	Phosphorus Trichloride	CASNO:	07719122
SYN:		CLASS:	370
NAME:	alpha-Picoline	CASNO:	00109068
SYN:	Methylpyridine,2	CLASS:	271
NAME:	Picric Acid	CASNO:	00088891
SYN:	Trinitrophenol,2,4,6	CLASS:	316 442
NAME:	Picric Acid, <30%	CASNO:	00088891
SYN:		CLASS:	316 442
NAME:	Polychlorinated Biphenyls (PCBs)	CASNO:	01336363
SYN:	Aroclor	CLASS:	265
NAME:	Potassium Bicarbonate	CASNO:	00298146
SYN:		CLASS:	540
NAME:	Potassium Bisulfate	CASNO:	07646937
SYN:		CLASS:	540
NAME:	Potassium Bisulfide	CASNO:	01310618
SYN:		CLASS:	540

CHEMICAL NAMES AND SYNONYMS

NAME: Potassium Bromate CASNO: 07758012
SYN: CLASS: 540

NAME: Potassium Bromide CASNO: 07758023
SYN: CLASS: 540

NAME: Potassium Carbonate CASNO: 00584087
SYN: CLASS: 540

NAME: Potassium Chlorate CASNO: 03811049
SYN: CLASS: 540

NAME: Potassium Chloride CASNO: 07447407
SYN: CLASS: 540

NAME: Potassium Chloride, <30% CASNO: 07447407
SYN: CLASS: 540

NAME: Potassium Chromate CASNO: 07789006
SYN: CLASS: 540

NAME: Potassium Cyanide CASNO: 00151508
SYN: CLASS: 215

NAME: Potassium Dichromate CASNO: 07778509
SYN: CLASS: 540

NAME: Potassium Dichromate, <30% CASNO: 07778509
SYN: CLASS: 540

NAME: Potassium Ferricyanide CASNO: 13746662
SYN: CLASS: 215

NAME: Potassium Ferrocyanide CASNO: 13943583
SYN: CLASS: 215

NAME: Potassium Fluoride CASNO: 07789233
SYN: CLASS: 540

NAME: Potassium Hydroxide CASNO: 01310583
SYN: CLASS: 380

NAME: Potassium Hydroxide, <30% CASNO: 01310583
SYN: CLASS: 380

NAME: Potassium Hydroxide, 30-70% CASNO: 01310583
SYN: CLASS: 380

NAME: Potassium Nitrate CASNO: 07757791
SYN: CLASS: 540

CHEMICAL NAMES AND SYNONYMS

NAME: Potassium Perchlorate CASNO: 07778747
SYN: CLASS: 540

NAME: Potassium Permanganate, <30% CASNO: 07722647
SYN: CLASS: 540

NAME: Potassium Persulfate CASNO: 07727211
SYN: CLASS: 540

NAME: Potassium Sulfate CASNO: 07778805
SYN: CLASS: 540

NAME: Potassium Sulfite CASNO: 10117381
SYN: CLASS: 540

NAME: Propane CASNO: 00074986
SYN: CLASS: 291

NAME: Propargyl Alcohol CASNO: 00107197
SYN: CLASS: 311

NAME: Beta-Propiolactone CASNO: 00057578
SYN: CLASS: 400

NAME: Propionic Acid CASNO: 00079094
SYN: CLASS: 102

NAME: Propionic Acid, 30-70% CASNO: 00079094
SYN: CLASS: 102

NAME: Propionic Acid, >70% CASNO: 00079094
SYN: CLASS: 102

NAME: Propionic Anhydride CASNO: 00123626
SYN: CLASS: 161

NAME: Propyl Acetate CASNO: 00109604
SYN: CLASS: 222

NAME: Propyl Acetate, >70% CASNO: 00109604
SYN: CLASS: 222

NAME: Propyl Alcohol CASNO: 00071238
SYN: Propanol CLASS: 311

NAME: n-Propylamine CASNO: 00107108
SYN: CLASS: 141

NAME: Propylene Oxide CASNO: 00075569
SYN: CLASS: 275

CHEMICAL NAMES AND SYNONYMS

NAME: Pyrethrins CASNO: 00121299
SYN: CLASS: 223

NAME: Pyridine CASNO: 00110861
SYN: CLASS: 271

NAME: Quinoline CASNO: 00091225
SYN: CLASS: 272

NAME: Resorcinol CASNO: 00108463
SYN: Benzendiol,1,3 CLASS: 316

NAME: Rubber and Plastic Waste CASNO: 99901500
SYN: CLASS: 999

NAME: Safrole CASNO: 00094597
SYN: CLASS: 278

NAME: Salicylic Acid CASNO: 00069727
SYN: CLASS: 316

NAME: Salt Solutions CASNO: 99901800
SYN: CLASS: 999

NAME: Silver Acetate CASNO: 00563633
SYN: CLASS: 222

NAME: Silver Cyanide CASNO: 00506649
SYN: CLASS: 215

NAME: Silver Nitrate CASNO: 07761888
SYN: CLASS: 540

NAME: Simulated Landfill CASNO: 99900800
SYN: CLASS: 999

NAME: Sodium Benzoate CASNO: 00532321
SYN: CLASS: 225

NAME: Sodium Bicarbonate CASNO: 00144558
SYN: CLASS: 540

NAME: Sodium Bicarbonate, <30% CASNO: 00144558
SYN: CLASS: 540

NAME: Sodium Biphosphate CASNO: 07558807
SYN: Sodium Phosphate Monobasic CLASS: 540

NAME: Sodium Bisulfite CASNO: 07631905
SYN: CLASS: 540

CHEMICAL NAMES AND SYNONYMS

NAME:	Sodium Borate	CASNO:	01330434
SYN:	Borax	CLASS:	540
NAME:	Sodium Borate, <30%	CASNO:	01330434
SYN:		CLASS:	540
NAME:	Sodium Bromide	CASNO:	07647156
SYN:		CLASS:	540
NAME:	Sodium Carbonate	CASNO:	00497198
SYN:		CLASS:	540
NAME:	Sodium Chlorate	CASNO:	07775099
SYN:		CLASS:	540
NAME:	Sodium Chloride	CASNO:	07647145
SYN:		CLASS:	540
NAME:	Sodium Chloride, <30%	CASNO:	07647145
SYN:		CLASS:	540
NAME:	Sodium Cyanide	CASNO:	00143339
SYN:		CLASS:	215
NAME:	Sodium Ferriccyanide	CASNO:	14217211
SYN:		CLASS:	215
NAME:	Sodium Ferrocyanide	CASNO:	13601199
SYN:		CLASS:	215
NAME:	Sodium Fluoride	CASNO:	07681494
SYN:		CLASS:	540
NAME:	Sodium Hydroxide	CASNO:	01310732
SYN:		CLASS:	380
NAME:	Sodium Hydroxide, <30%	CASNO:	01310732
SYN:		CLASS:	380
NAME:	Sodium Hydroxide, 30-70%	CASNO:	01310732
SYN:		CLASS:	380
NAME:	Sodium Hydroxide, >70%	CASNO:	01310732
SYN:		CLASS:	380
NAME:	Sodium Hypochlorite, <30%	CASNO:	07681529
SYN:		CLASS:	540
NAME:	Sodium Nitrate	CASNO:	07631994
SYN:		CLASS:	540

CHEMICAL NAMES AND SYNONYMS

NAME: Sodium Nitrite CASNO: 07632000
SYN: CLASS: 540

NAME: Sodium Sulfate CASNO: 07681381
SYN: CLASS: 540

NAME: Sodium Sulfide CASNO: 01313822
SYN: CLASS: 540

NAME: Stannous Chloride CASNO: 07772998
SYN: CLASS: 540

NAME: Stearic Acid CASNO: 00057114
SYN: CLASS: 102

NAME: Styrene CASNO: 00100425
SYN: CLASS: 292

NAME: Sulfur Dioxide CASNO: 07446095
SYN: CLASS: 350

NAME: Sulfur Dioxide, <30% CASNO: 07446095
SYN: CLASS: 350

NAME: Sulfur Trioxide CASNO: 07446119
SYN: CLASS: 350

NAME: Sulfuric Acid CASNO: 07664939
SYN: CLASS: 370

NAME: Sulfuric Acid, <30% CASNO: 07664939
SYN: CLASS: 370

NAME: Sulfuric Acid, 30-70% CASNO: 07664939
SYN: CLASS: 370

NAME: Sulfuric Acid, >70% CASNO: 07664939
SYN: CLASS: 370

NAME: Sulfur Monochloride CASNO: 12771083
SYN: CLASS: 370

NAME: Sulfurous Acid CASNO: 08882992
SYN: CLASS: 370

NAME: Sulfurous Acid, 30-70% CASNO: 08882992
SYN: CLASS: 370

NAME: Tannic Acid CASNO: 01401554
SYN: CLASS: 224

CHEMICAL NAMES AND SYNONYMS

NAME:	Tannic Acid, <30%	CASNO:	01401554
SYN:		CLASS:	224
NAME:	Tannic Acid, 30-70%	CASNO:	01401554
SYN:		CLASS:	224
NAME:	Tannic Acid, >70%	CASNO:	01401554
SYN:		CLASS:	224
NAME:	L-Tartaric Acid	CASNO:	00087694
SYN:	Tartaric Acid	CLASS:	104
NAME:	1,2,4,5-Tetrachlorobenzene	CASNO:	00095943
SYN:		CLASS:	263
NAME:	1,1,2,2-Tetrachloroethane	CASNO:	00079345
SYN:		CLASS:	261
NAME:	1,1,1,2-Tetrachloroethane	CASNO:	00630206
SYN:		CLASS:	261
NAME:	Tetrachloroethylene	CASNO:	00127184
SYN:	Perchloroethylene	CLASS:	261
NAME:	Tetraethyldithiopyrophosphate	CASNO:	03689245
SYN:	Dithiophosphoric Acid	CLASS:	460
NAME:	Tetraethyllead	CASNO:	00078002
SYN:		CLASS:	460
NAME:	Tetrahydrofuran	CASNO:	00109999
SYN:		CLASS:	277
NAME:	Tetranitomethane	CASNO:	00509148
SYN:		CLASS:	441
NAME:	Thionyl Chloride	CASNO:	07719097
SYN:		CLASS:	540
NAME:	Thiophene	CASNO:	00110021
SYN:		CLASS:	502
NAME:	Thiophenol	CASNO:	00108985
SYN:	Benzenethiol	CLASS:	501
NAME:	Toluene	CASNO:	00108883
SYN:		CLASS:	292
NAME:	Toluene Diisocyanate	CASNO:	00584849
SYN:		CLASS:	210

CHEMICAL NAMES AND SYNONYMS

NAME:	Toxic Pesticide Formulations	CASNO:	99901200
SYN:		CLASS:	999
NAME:	Toxic Pharmaceutical Waste	CASNO:	99901400
SYN:		CLASS:	999
NAME:	Tribromomethane	CASNO:	00075252
SYN:	Bromoform	CLASS:	261
NAME:	Tributyl Phosphate	CASNO:	00126738
SYN:		CLASS:	233
NAME:	Trichloroacetaldehyde	CASNO:	00075876
SYN:	Chloral	CLASS:	121 262
NAME:	1,2,4-Trichlorobenzene	CASNO:	00120821
SYN:		CLASS:	263
NAME:	1,1,2-Trichloroethane	CASNO:	00079005
SYN:		CLASS:	261
NAME:	Trichloroethylene	CASNO:	00079016
SYN:	Trichloroethene	CLASS:	261
NAME:	Trichloromethanethiol	CASNO:	00075707
SYN:		CLASS:	262 501
NAME:	Tricresyl Phosphate	CASNO:	01330785
SYN:		CLASS:	460
NAME:	Triethanolamine	CASNO:	00102716
SYN:		CLASS:	143
NAME:	Triethanolamine, >70%	CASNO:	00102716
SYN:		CLASS:	143
NAME:	Triethylamine	CASNO:	00121448
SYN:		CLASS:	143
NAME:	Trifluoroethanol	CASNO:	00075898
SYN:		CLASS:	311 262
NAME:	Trimethylamine	CASNO:	00075503
SYN:		CLASS:	143
NAME:	Tris(2,3-dibromopropyl) Phosphate	CASNO:	00126727
SYN:		CLASS:	460
NAME:	Turpentine	CASNO:	08006642
SYN:		CLASS:	291

CHEMICAL NAMES AND SYNONYMS

NAME: Urea
SYN:
CASNO: 00057136
CLASS: 132

NAME: Vinyl Acetate
SYN:
CASNO: 00108054
CLASS: 222

NAME: Vinyl Chloride
SYN: Chloroethene
CASNO: 00075014
CLASS: 530 261

NAME: Vinylidene Chloride
SYN: Dichloroethylene,1,1
CASNO: 00075354
CLASS: 261 530

NAME: Water
SYN:
CASNO: 07732185
CLASS: 550

NAME: Xylene
SYN:
CASNO: 00133207
CLASS: 292

NAME: o-Xylene
SYN:
CASNO: 00095476
CLASS: 292

NAME: p-Xylene
SYN:
CASNO: 00106423
CLASS: 292

NAME: Zinc Chloride
SYN:
CASNO: 07646857
CLASS: 540

NAME: Zinc Chloride, <30%
SYN:
CASNO: 07646857
CLASS: 540

NAME: Zinc Nitrate
SYN:
CASNO: 07779886
CLASS: 540

NAME: Zinc Nitrate, <30%
SYN:
CASNO: 07779886
CLASS: 540

NAME: Zinc Oxide
SYN:
CASNO: 01314132
CLASS: 540

NAME: Zinc Sulfate
SYN:
CASNO: 07733020
CLASS: 540

APPENDIX B

SUMMARY OF PUBLISHED CHEMICAL RESISTANCE INFORMATION

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DESCRIPTION OF DATA PRESENTATION FORMAT

All FML chemical resistance information considered in this study is contained in this appendix. The appendix is organized by liner type as indicated on the previous page. For each liner, the chemicals for which resistance information was found are listed alphabetically in the left column of the tables. The resistance information is listed under two principal headings: Ratings and Chemical Resistance Data.

Information under the Ratings heading originates from vendors' chemical resistance tables and literature sources where the vendor/author has constructed qualitative resistance ratings from his experience or research data. As described in Section 2, these ratings have been normalized on a scale of "a" to "d" with "a" indicating "excellent" resistance and "d" indicating "poor" resistance. The other two columns under the Ratings heading indicate the rating temperature and its source. The source is either a number corresponding to literature identified in the Reference Section to this report or a two-letter code corresponding to the vendor that supplied the rating (see Table 3).

Under the Chemical Resistance Data heading are data from tests performed on liner materials. The first column under Chemical Resistance Data is labeled Test and contains numerical codes representing test types as specified in Table B-1. The next two columns indicate the temperature and the time of the exposure of the FML to the chemical prior to its being tested for a change in physical properties. The test value is in the units indicated in Table B-1. When appropriate, test values are reported in exponential form. For example, 7(-5) is 7×10^{-5}.

The organization and consolidation of the vendor and the literature chemical resistance information necessarily required grouping liners by generic type. Thus, regardless of liner formulation or supplier, all information for a given base polymer was categorized together.

TABLE B-1. CHEMICAL RESISTANCE TESTS

Description	Data Reported As	Test Code*
Permeation	$g/m^2/hr$	1
Immersion followed by dimensional measurements	% swelling	2
Immersion followed by measurement of elongation at break	% change in elongation at break	3
Immersion followed by weighing	% weight change	5
Immersion followed by determination of tensile strength at break	% change in maximum strength	7
Immersion followed by determination of stress at 100% elongation	% change in 100% modulus	8
Hardness	Hardness points change	9
Immersion followed by determination of stress at 200% elongation	% change in 200% modulus	10
Soil permeability	cm/s	11

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*Test code numbers are used in column 5 of the data tables presented in Appendix B

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ASPHALT

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acidic Steel Pickling Waste	bc	23	31					
Aluminum Chloride	a	66	18					
Aluminum Potassium Sulfate	a	66	18					
Aluminum Sulfate	a	66	18					
Ammonium Chloride	a	66	18					
Ammonium Hydroxide	a	24	18					
Ammonium Nitrate	a	66	18					
Ammonium Sulfate	a	66	18					
Barium Chloride	a	66	18					
Barium Hydroxide	a	66	18					
Base Solutions	a	23	14					
Benzoic Acid	a	66	18					
Boric Acid	a	66	18					
Brine	a	23	14					
Calcium Bisulfite	a	66	18					
Calcium Chloride	a	66	18					
Calcium Hydroxide	a	24	18					
Calcium Nitrate	a	66	18					
Caustic Petroleum Sludge	bc	23	31					
Citric Acid	a	66	18					
Cupric Chloride	a	66	18					
Cupric Nitrate	a	66	18					
Cupric Sulfate	a	66	18					
Domestic Sewage	a	23	14					
Electroplating Sludge	bc	23	31					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ASPHALT

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Ethanol	a	66	18					
Ethylene Glycol	a	66	18					
Glycerol	a	66	18					
Hydrochloric Acid, >70%	a	24	18					
Hydrochloric Acid, <30%	a	66	18					
Hydrocyanic Acid	a	66	18					
Hydrogen Sulfide	a	66	18					
Lactic Acid	a	66	18					
Lead Acetate	a	66	18					
Magnesium Chloride	a	66	18					
Magnesium Hydroxide	a	66	18					
Magnesium Nitrate	a	66	18					
Magnesium Sulphate	a	66	18					
Mild Acids	a	23	14					
Nickel Chloride	a	66	18					
Nickel Nitrate	a	66	18					
Nickel Sulfate	a	66	18					
Oil Refinery Sludge	d	23	31					
Oily-Aromatic Oil	d	23	14					
Oxalic Acid	a	66	18					
Oxidizing Acids	d	23	14					
Petroleum Oil - No Aromatics	d	23	14					
Phosphoric Acid	a	66	18					
Phosphorus Trichloride	a	66	18					
Potassium Bicarbonate	a	66	18					
Potassium Carbonate	a	66	18					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ASPHALT

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Potassium Chloride	a	66	18					
Potassium Cyanide	a	66	18					
Potassium Ferricyanide	a	66	18					
Potassium Ferrocyanide	a	66	18					
Potassium Hydroxide, <30%	a	24	18					
Potassium Nitrate	a	66	18					
Potassium Sulfate	a	66	18					
Rubber and Plastic Waste	a	23	31					
Salicylic Acid	a	66	18					
Salt Solutions	a	23	14					
Silver Nitrate	a	66	18					
Sodium Bicarbonate	a	66	18					
Sodium Carbonate	a	66	18					
Sodium Chloride	a	66	18					
Sodium Cyanide	a	66	18					
Sodium Hydroxide, <30%	a	24	18					
Sodium Nitrate	a	66	18					
Sodium Sulfate	a	66	18					
Sodium Sulfide	a	66	18					
Sulfur Dioxide	a	66	18					
Sulfur Trioxide	a	66	18					
Sulfurous Acid	a	66	18					
Tannic Acid	a	66	18					
L-Tartaric Acid	a	66	18					
Toxic Pesticide Formulations	bc	23	31					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ASPHALT

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Toxic Pharmaceutical Waste	bc	23	31					
Urea	a	66	18					
Water	a	23	14					
Zinc Chloride	a	66	18					
Zinc Nitrate	a	66	18					
Zinc Sulfate	a	66	18					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ASPHALT CONCRETE

	RATINGS			CHEMICAL RESISTANCE DATA					
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value	(Exponent)	Reference
Acidic Steel Pickling Waste	bc	23	31						
Base Solutions	a	23	14						
Brine	a	23	14						
Caustic Petroleum Sludge	bc	23	31						
Domestic Sewage	a	23	14						
Electroplating Sludge	bc	23	31						
Mild Acids	a	23	14						
Oil Refinery Sludge	d	23	31						
Oily-Aromatic Oil	d	23	14						
Oxidizing Acids	d	23	14						
Petroleum Oil - No Aromatics	d	23	14						
Rubber and Plastic Waste	a	23	31						
Salt Solutions	bc	23	14						
Simulated Landfill				11	23	365.0	7.40	(-7)	33
				11	23	365.0	9.30	(-9)	33
				11	23	1703.0	< 1.00	(-7)	33
Toxic Pesticide Formulations	bc	23	31						
Toxic Pharmaceutical Waste	bc	23	31						
Water	a	23	14						

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLORINATED PE/POLYETHYLENE/CHLORINATED PE LAMINATE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Toluene, <30%				1	23	0.0	0.36	2
Xylene, <30%				1	23	0.0	0.17	2

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLORINATED POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetic Acid, <30%				5	24	2.9	2.70	WS
				5	24	11.0	5.40	WS
				5	24	81.0	17.60	WS
Acetone	d	23	DW					
				5	24	2.9	44.00	WS
				5	24	11.0	43.50	WS
				5	24	81.0	40.40	WS
Acidic Steel Pickling Waste	bc	23	31					
Alkaline-Spent Caustic				3	23	1250.0	15.00	33
				5	23	780.0	1.10	33
				8	23	1250.0	32.00	33
Aluminum Chloride	a	70	DW					
Ammonium Hydroxide, <30%				5	24	2.9	4.70	WS
				5	24	11.0	9.60	WS
				5	24	81.0	34.70	WS
Aniline				5	24	2.9	135.00	WS
				5	24	11.0	125.00	WS
				5	24	81.0	134.00	WS
Base Solutions	a	23	14					
Benzene	d	23	DW					
				5	24	2.9	> 1000.00	WS
Brine	a	23	14					
Calcium Chloride	a	70	DW					
Carbon Tetrachloride	d	23	DW					
				5	24	2.9	137.00	WS
				5	24	11.0	123.00	WS
				5	24	81.0	> 1000.00	WS
Caustic Petroleum Sludge	a	23	31					
Chromic Acid, <30%	a	23	DW					
Citric Acid, <30%	a	70	DW					
				5	24	2.9	2.00	WS
				5	24	11.0	3.30	WS
				5	24	81.0	7.00	WS
Cupric Sulfate	a	70	DW					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLORINATED POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Cyclohexane	d	23	DW					
Dimethylformamide				5	24	2.9	110.30	WS
				5	24	11.0	110.00	WS
				5	24	81.0	99.80	WS
Domestic Sewage	a	23	14					
Electroplating Sludge	bc	23	31					
Ethanol, 30-70%				5	24	2.9	4.20	WS
				5	24	11.0	7.80	WS
				5	24	81.0	16.70	WS
Ethanol, >70%	a	23	DW	3	23	7.0	16.70	31
				3	23	28.0	2.10	31
				7	23	7.0	-17.50	31
				7	23	28.0	-18.90	31
				8	23	7.0	70.40	31
				8	23	28.0	74.00	31
Ethyl Acetate				5	24	2.9	75.50	WS
				5	24	11.0	68.50	WS
				5	24	81.0	> 1000.00	WS
Ethylene Glycol	a	23	DW					
Ferric Chloride, <30%	a	70	DW					
Hexane				5	24	2.9	4.50	WS
				5	24	11.0	2.50	WS
				5	24	81.0	1.00	WS
Hydrochloric Acid, <30%				5	24	2.9	1.80	WS
				5	24	11.0	3.00	WS
				5	24	81.0	7.40	WS
Hydrocloric Acid, 30-70%	a	23	DW					
Hydrofluoric Acid				5	23	761.0	12.90	33
Hydrogen Peroxide, <30%				5	24	2.9	1.30	WS
				5	24	11.0	3.00	WS
				5	24	81.0	10.30	WS
Isooctane				5	24	2.9	2.30	WS
				5	24	11.0	2.00	WS
				5	24	81.0	0.60	WS
Kerosene				5	24	2.9	11.60	WS
				5	24	11.0	13.00	WS

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLORINATED POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Kerosene				5	24	81.0	12.40	WS
Lactic Acid	a	70	DW					
Lead-Low Lead Gasoline Washwater				3	23	1340.0	-16.00	33
				5	23	786.0	118.90	33
				8	23	1340.0	-28.00	33
Methanol, >70%				5	24	2.9	2.00	WS
				5	24	11.0	2.60	WS
				5	24	81.0	-0.30	WS
Mild Acids	a	23	14					
Municipal Solid Waste				2	23	243.0	7.90	33
				2	23	578.0	14.40	33
				2	23	928.0	9.95	33
				3	23	365.0	-2.00	33
				3	23	1703.0	-6.00	33
				5	23	365.0	9.00	33
				5	23	365.0	12.40	33
				5	23	365.0	10.30	33
				7	23	365.0	20.00	33
				7	23	1703.0	-14.00	33
				9	23	365.0	-11.50	33
				9	23	1703.0	-7.00	33
				10	23	365.0	-18.00	33
				10	23	1703.0	-14.00	33
				10	23	243.0	-15.00	33
				10	23	243.0	-11.00	33
				10	23	243.0	-2.00	33
				10	23	578.0	-11.00	33
				10	23	578.0	-10.00	33
				10	23	578.0	6.00	33
				10	23	943.0	-5.00	33
				10	23	943.0	4.00	33
				10	23	943.0	33.00	33
Nitric Acid				3	23	1220.0	-12.00	33
				5	23	751.0	19.90	33
				8	23	1220.0	-16.00	33
Nitric Acid, <30%				5	24	2.9	1.70	WS
				5	24	11.0	3.00	WS
				5	24	81.0	15.50	WS
Nitric Acid, 30-70%				5	24	2.9	4.00	WS
				5	24	11.0	12.00	WS
				5	24	81.0	47.00	WS
Oil Refinery Sludge	d	23	31					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLORINATED POLYETHYLENE

Chemical	RATINGS Rating	RATINGS Deg C	RATINGS Reference	CHEMICAL RESISTANCE DATA Test	Deg C	Days	Test Value (Exponent)	Reference
Oily-Aromatic Oil	d	23	14	5	23	761.0	226.40	33
Oily-Oil Pond 104				5	23	752.0	36.90	33
Oleic Acid	a	23	DW	5	24	2.9	2.00	WS
				5	24	11.0	3.80	WS
				5	24	81.0	6.20	WS
Oxalic Acid, <30%	a	23	DW					
Oxidizing Acids	d	23	14					
Pesticide - Weed Killer				3	23	1260.0	-10.00	33
				5	23	807.0	12.70	33
				8	23	1260.0	14.00	33
Petroleum Oil - No Aromatics	a	23	14					
Phenol, <30%				5	24	2.9	13.30	WS
				5	24	11.0	22.60	WS
				5	24	81.0	29.00	WS
Phosphoric Acid, 30-70%	a	70	DW					
Potassium Hydroxide	a	70	DW					
Rubber and Plastic Waste	a	23	31					
Salt Solutions	a	23	14					
Sodium Borate	a	70	DW					
Sodium Carbonate	a	70	DW					
Sodium Hydroxide, <30%				5	24	2.9	3.00	WS
				5	24	11.0	8.00	WS
				5	24	81.0	15.60	WS
Sodium Hydroxide, 30-70%	a	70	DW	5	24	2.9	0.70	WS
				5	24	11.0	1.00	WS
				5	24	81.0	0.70	WS
Sodium Hypochlorite, <30%	a	70	DW					
Sulfuric Acid, <30%				5	24	2.9	1.40	WS
				5	24	11.0	2.80	WS
				5	24	81.0	6.70	WS

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLORINATED POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Sulfuric Acid, 30-70%	a	70	DW					
Toluene	d	23	DW	5	24	2.9	> 1000.00	WS
Toluene, <30%				1	23	0.0	0.21	2
Toxic Pesticide Formulations	bc	23	31					
Toxic Pharmaceutical Waste	bc	23	31					
Tributyl Phosphate				3	23	523.0	55.00	33
				7	23	523.0	-90.00	33
				8	23	523.0	-94.00	33
				9	23	523.0	-60.00	33
Trichloroethylene	d	23	DW					
Trichloroethylene, <30%				1	23	0.0	0.25	2
Turpentine				5	24	2.9	30.60	WS
				5	24	11.0	31.00	WS
				5	24	81.0	30.70	WS
Water	a	70	DW					
	a	23	14					
				1	23	0.0	0.03	12
				1	23	0.0	0.06	12
				1	23	0.0	0.01	12
				1	23	0.0	0.01	12
				1	23	0.0	0.01	12
				1	23	0.0	0.03	12
				5	24	2.9	2.00	WS
				5	24	11.0	3.50	WS
				5	24	81.0	10.70	WS
				5	23	365.0	13.10	33
				5	23	365.0	19.60	33
				5	23	365.0	15.50	33
Xylene	d	23	DW					
Xylene, <30%				1	23	0.0	0.10	2

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLOROSULFONATED POLYETHYLENE

Chemical	RATINGS Rating	RATINGS Deg C	RATINGS Reference	CHEMICAL RESISTANCE DATA Test	CHEMICAL RESISTANCE DATA Deg C	CHEMICAL RESISTANCE DATA Days	CHEMICAL RESISTANCE DATA Test Value (Exponent)	CHEMICAL RESISTANCE DATA Reference
Acetic Acid, <30%				5	24	2.9	1.20	WS
				5	24	11.0	2.20	WS
				5	24	81.0	6.60	WS
Acetic Anhydride	a	23	DU					
Acetone				5	24	2.9	7.20	WS
				5	24	11.0	7.00	WS
				5	24	81.0	7.70	WS
Acidic Steel Pickling Waste	a	23	31					
Alkaline-Spent Caustic				3	23	1250.0	-32.00	33
				5	23	780.0	4.30	33
				5	23	780.0	3.30	33
				8	23	1250.0	99.00	33
Aluminum Potassium Sulfate	a	23	DU					
Aluminum Sulfate	a	70	DU					
Ammonium Hydroxide, <30%				5	24	2.9	2.00	WS
				5	24	11.0	4.50	WS
				5	24	81.0	14.00	WS
Ammonium Sulfate	a	70	DU					
Amyl Acetate	d	23	DU					
Aniline				5	24	2.3	23.20	WS
				5	24	11.0	21.00	WS
				5	24	81.0	21.60	WS
Barium Hydroxide	a	70	DU					
Base Solutions	a	23	14					
Benzene	d	23	DU	5	24	2.9	> 1000.00	WS
Boric Acid	a	70	DU					
Brine	a	23	14					
Butane	a	23	DU					
Calcium Bisulfite	a	70	DU					
Calcium Hydroxide	a	70	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLOROSULFONATED POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Calcium Hypochlorite, <30%	a	70	DU					
Carbon Tetrachloride	d	23	DU					
				5	24	2.9	> 1000.00	WS
Caustic Petroleum Sludge	a	23	31					
Chromic Acid, 30-70%	a	70	DU					
Citric Acid	a	23	DU					
				5	24	2.9	1.00	WS
				5	24	11.0	0.90	WS
				5	24	81.0	0.30	WS
Cyclohexane	d	23	DU					
Dimethylformamide								
				5	24	2.9	10.80	WS
				5	24	11.0	11.00	WS
				5	24	81.0	10.70	WS
Di-n-octyl Phthalate	d	23	DU					
Domestic Sewage	a	23	14					
Electroplating Sludge	a	23	31					
Ethanol	a	70	DU					
Ethanol, 30-70%				5	24	2.9	0.80	WS
				5	24	11.0	0.90	WS
				5	24	81.0	0.10	WS
Ethanol, >70%				3	23	7.0	-7.40	31
				3	23	28.0	-24.60	31
				7	23	7.0	-21.80	31
				7	23	28.0	12.50	31
				8	23	7.0	-18.90	31
				8	23	28.0	-12.70	31
Ethyl Acetate	d	23	DU					
				5	24	2.9	16.00	WS
				5	24	11.0	16.50	WS
				5	24	81.0	13.70	WS
Ethylene Glycol	a	70	DU					
Fluoboric Acid	a	23	DU					
Fluosilicic Acid	a	70	DU					
Formic Acid	a	23	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLOROSULFONATED POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Glycerol	a	70	DU					
Hexane				5	24	2.9	7.40	WS
				5	24	11.0	7.80	WS
				5	24	81.0	10.40	WS
Hydrochloric Acid, <30%				5	24	2.9	0.20	WS
				5	24	11.0	0.90	WS
				5	24	81.0	0.08	WS
Hydrocloric Acid, 30-70%	a	70	DU					
Hydrofluoric Acid				5	23	761.0	9.00	33
				5	23	761.0	7.70	33
Hydrogen Peroxide, <30%				5	24	2.9	0.20	WS
				5	24	11.0	0.90	WS
				5	24	81.0	0.30	WS
Isooctane				5	24	2.9	5.00	WS
				5	24	11.0	5.20	WS
				5	24	81.0	7.00	WS
Kerosene				5	24	2.9	30.70	WS
				5	24	11.0	26.70	WS
				5	24	81.0	42.50	WS
Lactic Acid	a	23	DU					
Lead-Low Lead Gasoline Washwater				3	23	1340.0	-19.00	33
				5	23	786.0	120.70	33
				5	23	786.0	116.20	33
				8	23	1340.0	18.00	33
Magnesium Chloride	a	70	DU					
Magnesium Hydroxide	a	70	DU					
Methanol	a	70	DU	5	24	2.9	0.60	WS
				5	24	11.0	0.60	WS
				5	24	81.0	0.20	WS
Methylene Chloride	d	23	DU					
Mild Acids	a	23	14					
Municipal Solid Waste				2	23	243.0	18.60	33
				2	23	578.0	22.80	33
				2	23	928.0	17.24	33
				3	23	365.0	20.00	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLOROSULFONATED POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Municipal Solid Waste				3	23	1703.0	-6.00	33
				5	23	365.0	20.00	33
				5	23	365.0	19.00	33
				5	23	365.0	13.64	33
				5	23	365.0	8.71	33
				7	23	365.0	-7.00	33
				7	23	1703.0	20.00	33
				9	23	365.0	-15.00	33
				9	23	1703.0	-9.00	33
				10	23	365.0	-18.00	33
				10	23	1703.0	20.00	33
				10	23	243.0	-46.00	33
				10	23	243.0	-23.00	33
				10	23	578.0	-54.00	33
				10	23	578.0	8.00	33
				10	23	943.0	-43.00	33
				10	23	943.0	30.00	33
Napthalene	d	23	DU					
Nitric Acid				3	23	1220.0	-17.00	33
				5	23	751.0	10.00	33
				5	23	751.0	10.90	33
				8	23	1220.0	12.00	33
Nitric Acid, <30%				5	24	2.9	0.40	WS
				5	24	11.0	0.50	WS
				5	24	81.0	3.00	WS
Nitric Acid, 30-70%				5	24	2.9	1.30	WS
				5	24	11.0	2.70	WS
				5	24	81.0	13.00	WS
Nitrobenzene	d	23	DU					
Oil Refinery Sludge	d	23	31					
Oily-Aromatic Oil	d	23	14					
				5	23	761.0	105.20	33
				5	23	761.0	110.50	33
Oily-Oil Pond 104				5	23	752.0	49.50	33
				5	23	752.0	55.00	33
Oily-Weed Oil				5	23	809.0	358.40	33
				5	23	809.0	347.00	33
Oleic Acid				5	24	2.9	5.50	WS
				5	24	11.0	7.80	WS
				5	24	81.0	8.60	WS
Oxidizing Acids	d	23	14					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLOROSULFONATED POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Pesticide - Weed Killer								
				3	23	1260.0	-12.00	33
				5	23	807.0	17.30	33
				5	23	807.0	15.70	33
				8	23	1260.0	18.00	33
Petroleum Oil - No Aromatics	bc	23	14					
Phenol, <30%								
				5	24	2.9	5.60	WS
				5	24	11.0	6.00	WS
				5	24	81.0	6.00	WS
Picric Acid	a	23	DU					
Potassium Dichromate	a	70	DU					
Potassium Hydroxide	a	70	DU					
Rubber and Plastic Waste	a	23	31					
Salt Solutions	a	23	14					
Sodium Borate	a	70	DU					
Sodium Chloride	a	23	DU					
Sodium Hydroxide, <30%	a	70	DU					
				5	24	2.9	0.40	WS
				5	24	11.0	0.70	WS
				5	24	81.0	0.50	WS
Sodium Hydroxide, 30-70%				5	24	2.9	0.30	WS
				5	24	11.0	1.00	WS
				5	24	81.0	0.50	WS
Sodium Hypochlorite, <30%	a	70	DU					
Stannous Chloride	a	70	DU					
Sulfuric Acid, 30-70%								
				5	24	2.9	0.20	WS
				5	24	11.0	0.70	WS
				5	24	81.0	0.30	WS
				5	24	2.9	0.20	WS
				5	24	11.0	0.70	WS
				5	24	81.0	-0.50	WS
Tannic Acid	a	23	DU					
Toluene	d	23	DU					
				5	24	2.9	> 1000.00	WS
Toxic Pesticide Formulations	bc	23	31					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: CHLOROSULFONATED POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Toxic Pharmaceutical Waste	bc	23	31					
Tributyl Phosphate	d	23	DU					
				3	23	523.0	-21.00	33
				7	23	523.0	-52.00	33
				8	23	523.0	-20.00	33
				9	23	523.0	-14.00	33
Trichloroethylene	d	23	DU					
Triethanolamine	a	70	DU					
Turpentine	d	23	DU					
				5	24	2.9	125.80	WS
				5	24	11.0	123.00	WS
				5	24	81.0	> 1000.00	WS
Water	a	70	DU					
	a	23	14					
				1	23	0.0	0.01	12
				1	23	0.0	0.03	12
				1	23	0.0	0.02	12
				1	23	0.0	0.03	12
				1	23	0.0	0.02	12
				1	23	0.0	0.01	12
				5	24	2.9	0.80	WS
				5	24	11.0	0.90	WS
				5	24	81.0	1.20	WS
				5	70	214.0	30.00	WS
				5	100	447.0	30.00	WS
				5	23	365.0	17.40	33
				5	23	365.0	18.00	33
				5	23	365.0	9.20	33
				5	23	365.0	11.20	33
Xylene	d	23	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: EPICHLOROHYDRIN-ETHYLENE OXIDE COPOLYMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetone				2	24	7.0	100.00	HE
				3	24	7.0	48.00	HE
				7	24	7.0	-21.00	HE
				8	24	7.0	37.00	HE
				9	24	7.0	-23.00	HE
n-Butyl Phthalate				2	24	7.0	80.00	HE
				3	24	7.0	-50.00	HE
				7	24	7.0	31.00	HE
				8	24	7.0	10.00	HE
				9	24	7.0	-31.00	HE
Chromic Acid, <30%	d	22	HE					
	d	100	HE					
Ethyl Acetate				2	24	7.0	95.00	HE
				3	24	7.0	-56.00	HE
				7	24	7.0	-33.00	HE
				8	24	7.0	39.00	HE
				9	24	7.0	-21.00	HE
Ethylene Glycol				2	24	7.0	2.00	HE
				3	24	7.0	12.00	HE
				7	24	7.0	5.00	HE
				8	24	7.0	20.00	HE
				9	24	7.0	4.00	HE
Hydrochloric Acid, <30%	a	22	HE					
	bc	100	HE					
Hydrocloric Acid, 30-70%	d	22	HE					
	d	100	HE					
Kerosene				2	24	7.0	2.00	HE
				3	24	7.0	-6.00	HE
				7	24	7.0	< 0.01	HE
				8	24	7.0	7.00	HE
				9	24	7.0	-10.00	HE
Methanol				2	24	7.0	19.00	HE
				3	24	7.0	-20.00	HE
				7	24	7.0	-9.00	HE
				8	24	7.0	-2.00	HE
				9	24	7.0	-10.00	HE
Nitric Acid, <30%	d	22	HE					
	d	100	HE					
Nitric Acid, >70%	d	22	HE					
	d	100	HE					
Oleic Acid				2	24	7.0	5.00	HE

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: EPICHLOROHYDRIN-ETHYLENE OXIDE COPOLYMER

Chemical	RATINGS Rating	 Deg C	 Reference	CHEMICAL RESISTANCE DATA Test	 Deg C	 Days	 Test Value (Exponent)	 Reference
Oleic Acid								
				3	24	7.0	-20.00	HE
				7	24	7.0	2.00	HE
				8	24	7.0	22.00	HE
				9	24	7.0	-9.00	HE
Phosphoric Acid, <30%	a	22	HE					
	a	100	HE					
Phosphoric Acid, >70%	bc	22	HE					
	d	100	HE					
Sodium Hydroxide, <30%	a	22	HE					
	a	100	HE					
Sodium Hydroxide, 30-70%	a	22	HE					
	d	100	HE					
Sulfuric Acid, <30%	bc	22	HE					
	bc	100	HE					
Sulfuric Acid, >70%	a	22	HE					
	a	100	HE					
Tetrachloroethylene								
				2	24	7.0	28.00	HE
				3	24	7.0	-20.00	HE
				7	24	7.0	-3.00	HE
				8	24	7.0	25.00	HE
				9	24	7.0	-15.00	HE
Toluene								
				2	24	7.0	95.00	HE
				3	24	7.0	-52.00	HE
				7	24	7.0	-32.00	HE
				8	24	7.0	15.00	HE
				9	24	7.0	-19.00	HE
Turpentine								
				2	24	7.0	8.00	HE
				3	24	7.0	-12.00	HE
				7	24	7.0	-12.00	HE
				8	24	7.0	5.00	HE
				9	24	7.0	-4.00	HE
Water								
				2	24	7.0	1.00	HE
				3	24	7.0	20.00	HE
				7	24	7.0	8.00	HE
				8	24	7.0	12.00	HE
				9	24	7.0	-7.00	HE

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ETHYLENE-BITUMEN COPOLYMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetic Acid, <30%				1	23	0.0	< 0.01	2
Acetone, <30%				1	23	0.0	0.01	2
Carbon Tetrachloride, <30%				1	23	0.0	0.08	2
Chloroform, <30%				1	23	0.0	2.00	2
Methanol, <30%				1	23	0.0	< 0.01	2
Toluene, <30%				1	23	0.0	0.63	2
Trichloroethylene, <30%				1	23	0.0	0.33	2
Xylene, <30%				1	23	0.0	0.29	2

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ETHYLENE-PROPYLENE-DIENE TERPOLYMER (EPDM)

	RATINGS			CHEMICAL RESISTANCE DATA					
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value	(Exponent)	Reference
Acetic Acid, <30%	a	23	DU	1	23	0.0	< 0.01		2
Acetic Acid, >70%	bc	23	DU						
Acetone	a	23	DU						
Acetone, <30%				1	23	0.0	0.08		2
Acidic Steel Pickling Waste	a	23	31						
Alkaline-Spent Caustic				3	23	1250.0	-5.00		33
				5	23	780.0	1.30		33
				8	23	1250.0	9.00		33
Aluminum Sulfate	a	23	DU						
Ammonium Hydroxide	a	23	DU						
Ammonium Sulfate	a	23	DU						
Amyl Acetate	a	23	DU						
Barium Hydroxide	a	23	DU						
Benzene	d	23	DU						
Boric Acid	a	23	DU						
Butane	bc	23	DU						
Butyraldehyde	bc	23	DU						
Calcium Chloride	a	23	DU						
Calcium Hydroxide	a	23	DU						
Calcium Hypochlorite	a	23	DU						
Carbon Tetrachloride	d	23	DU						
Caustic Petroleum Sludge	a	23	31						
Chlorine, <30%	d	23	DU						
Chromic Acid, <30%	d	23	DU						
Citric Acid	a	23	DU						
Cyclohexane	d	23	DU						
Di-n-octyl Phthalate	d	23	DU						

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ETHYLENE-PROPYLENE-DIENE TERPOLYMER (EPDM)

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Electroplating Sludge	a	23	31					
Ethanol	a	23	DU					
Ethyl Acetate	a	23	DU					
Ethylene Glycol	a	23	DU					
Ferric Chloride	a	23	DU					
Formic Acid	a	23	DU					
Furfural	d	23	DU					
Gasoline	d	23	DU					
Glycerol	a	23	DU					
Hydrocloric Acid, 30-70%	bc	23	DU					
Hydrocyanic Acid	a	23	DU					
Hydrofluoric Acid				5	23	761.0	12.90	33
Hydrofluoric Acid, 30-70%	bc	23	DU					
Hydrofluoric Acid, >70%	d	23	DU					
Hydrogen Sulfide	a	23	DU					
Kerosene	d	23	DU					
Lactic Acid	a	23	DU					
Lead-Low Lead Gasoline Washwater				3	23	1340.0	6.00	33
				5	23	786.0	34.70	33
				8	23	1340.0	9.00	33
Magnesium Chloride	a	70	DU					
Magnesium Hydroxide	a	70	DU					
Methanol	a	70	DU					
Methanol, <30%				1	23	0.0	< 0.01	2
Methylene Chloride	bc	23	DU					
Methyl Ethyl Ketone	a	23	DU					
Municipal Solid Waste				2	23	243.0	2.90	33
				2	23	578.0	3.80	33
				2	23	928.0	5.98	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ETHYLENE-PROPYLENE-DIENE TERPOLYMER (EPDM)

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Municipal Solid Waste				3	23	365.0	5.00	33
				3	23	1703.0	-10.00	33
				5	23	365.0	5.95	33
				5	23	365.0	5.50	33
				5	23	365.0	5.99	33
				5	23	365.0	8.99	33
				7	23	365.0	-18.00	33
				7	23	1703.0	-17.00	33
				9	23	365.0	-2.50	33
				9	23	1703.0	-3.00	33
				10	23	365.0	-2.00	33
				10	23	1703.0	6.00	33
				10	23	243.0	34.00	33
				10	23	243.0	11.00	33
				10	23	243.0	< 0.01	33
				10	23	243.0	-9.00	33
				10	23	578.0	31.00	33
				10	23	578.0	9.00	33
				10	23	578.0	-1.00	33
				10	23	578.0	-8.00	33
				10	23	943.0	34.00	33
				10	23	943.0	17.00	33
				10	23	943.0	5.00	33
				10	23	943.0	-2.00	33
Naphtha, V.M.& P	d	23	DU					
Nitric Acid				3	23	1150.0	-21.00	33
				5	23	751.0	50.90	33
				8	23	1150.0	-30.00	33
Nitric Acid, 30-70%	bc	23	DU					
Nitrobenzene	a	23	DU					
Oil Refinery Sludge	d	23	31					
Oily-Aromatic Oil				5	23	761.0	34.20	33
Oily-Oil Pond 104				5	23	752.0	84.70	33
Oily-Weed Oil				5	23	809.0	76.20	33
Oleic Acid	bc	23	DU					
Palmitic Acid	bc	23	DU					
Pesticide - Weed Killer				3	23	1260.0	3.00	33
				5	23	807.0	10.40	33
				8	23	1260.0	-12.00	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ETHYLENE-PROPYLENE-DIENE TERPOLYMER (EPDM)

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Phenol	bc	23	DU					
Phosphoric Acid, >70%	a	23	DU					
Picric Acid	bc	23	DU					
Rubber and Plastic Waste	a	23	31					
Sodium Borate	a	23	DU					
Sodium Hydroxide, <30%	a	23	DU					
Sulfuric Acid, 30-70%	bc	23	DU					
Sulfuric Acid, >70%	d	23	DU					
Tannic Acid, <30%	a	23	DU					
Tetrachloroethylene	d	23	DU					
Toluene	d	23	DU					
Toluene, <30%				1	23	0.0	0.50	2
Toxic Pesticide Formulations	bc	23	31					
Toxic Pharmaceutical Waste	bc	23	31					
Trichloroethylene	d	23	DU					
Triethanolamine	a	23	DU					
Turpentine	d	23	DU					
Water				1	23	0.0	0.01	12
				1	23	0.0	0.01	12
				1	23	0.0	0.01	12
				5	23	365.0	1.40	33
				5	23	365.0	4.80	33
				5	23	365.0	1.50	33
				5	23	365.0	1.60	33
Xylene	d	23	DU					
Xylene, <30%				1	23	0.0	0.13	2

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ETHYLENE VINYL ACETATE COPOLYMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetic Acid, <30%	a	25	GU					
Acetic Acid, >70%	a	25	GU					
Acetone	d	25	GU					
Aluminum Chloride, <30%	a	25	GU					
Aluminum Sulfate, <30%	a	25	GU					
Ammonium Chloride, <30%	a	25	GU					
Ammonium Hydroxide, <30%	a	25	GU					
Ammonium Hydroxide, >70%	a	25	GU					
Ammonium Nitrate, <30%	a	25	GU					
Ammonium Phosphate, <30%	a	25	GU					
Amyl Acetate	d	25	GU					
Aniline	d	25	GU					
Barium Chloride, <30%	a	25	GU					
Barium Hydroxide	a	25	GU					
Barium Sulfide, <30%	a	25	GU					
Benzaldehyde	d	25	GU					
Benzene	d	25	GU					
Benzyl Alcohol	d	25	GU					
Benzyl Chloride	d	25	GU					
Boric Acid, <30%	a	25	GU					
Bromobenzene	d	25	GU					
Calcium Chloride, <30%	a	25	GU					
Calcium Hydroxide	a	25	GU					
Calcium Hypochlorite, <30%	a	25	GU					
Carbon Disulfide	d	25	GU					
Carbon Tetrachloride	d	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ETHYLENE VINYL ACETATE COPOLYMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Chloroform	d	25	GU					
Chlorosulfonic Acid, <30%	d	25	GU					
Chromic Acid, <30%	d	25	GU					
Chromic Acid, >70%	d	25	GU					
Citric Acid, <30%	a	25	GU					
Cupric Chloride, <30%	a	25	GU					
Cupric Sulfate, <30%	a	25	GU					
Cyclohexane	d	25	GU					
Dibenzyl Ether	d	25	GU					
Diethylene Glycol Monobutyl Ethe	d	25	GU					
Di-n-octyl Phthalate	d	25	GU					
Ethanol	a	25	GU					
Ethyl Acetate	d	25	GU					
Ethyl Ether	d	25	GU					
Ethyl Benzene	d	25	GU					
Ethylene Glycol Monoethyl Ether	d	25	GU					
Ethylene Dichloride	d	25	GU					
Ethylene Glycol	a	25	GU					
Ferric Chloride, <30%	bc	25	GU					
Ferric Nitrate, <30%	bc	25	GU					
Ferrous Sulfate, <30%	a	25	GU					
Formic Acid, <30%	a	25	GU					
Furfural	d	25	GU					
Glycerol	a	25	GU					
Heptane	d	25	GU					
Hexane	d	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ETHYLENE VINYL ACETATE COPOLYMER

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
1-Hexanol	a	25	GU					
Hydrochloric Acid, >70%	bc	25	GU					
Hydrochloric Acid, <30%	a	25	GU					
Hydrofluoric Acid, >70%	bc	25	GU					
Isopropyl Alcohol	a	25	GU					
Lactic Acid, <30%	a	25	GU					
Magnesium Chloride, <30%	a	25	GU					
Magnesium Sulphate, <30%	a	25	GU					
Methanol, <30%	a	25	GU					
Methyl Ethyl Ketone	d	25	GU					
Methyl Isobutyl Ketone	d	25	GU					
Napthalene	d	25	GU					
Nickel Sulfate, <30%	a	25	GU					
Nitric Acid, <30%	a	25	GU					
Nitrobenzene	d	25	GU					
Oleic Acid, >70%	d	25	GU					
Oxalic Acid, <30%	a	25	GU					
Phenol, <30%	a	25	GU					
Phenol, >70%	d	25	GU					
Phosphoric Acid, >70%	bc	25	GU					
Picric Acid, <30%	a	25	GU					
Potassium Chloride, <30%	a	25	GU					
Potassium Dichromate, <30%	a	25	GU					
Potassium Hydroxide, <30%	a	25	GU					
Potassium Permanganate, <30%	d	25	GU					
Resorcinol	a	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ETHYLENE VINYL ACETATE COPOLYMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Sodium Bicarbonate, <30%	a	25	GU					
Sodium Borate, <30%	a	25	GU					
Sodium Chloride, <30%	a	25	GU					
Sodium Hydroxide, <30%	a	25	GU					
Sodium Hydroxide, >70%	a	25	GU					
Stearic Acid	a	25	GU					
Sulfuric Acid, <30%	a	25	GU					
Sulfuric Acid, >70%	bc	25	GU					
Tannic Acid	a	25	GU					
L-Tartaric Acid	a	25	GU					
Tetrachloroethylene	d	25	GU					
Toluene	d	25	GU					
Tricresyl Phosphate	d	25	GU					
Triethanolamine	d	25	GU					
Xylene	d	25	GU					
Zinc Nitrate, <30%	a	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
	a	60	SL					
	a	23	4					
	a	23	4					
Acetaldehyde	a	20	SF					
	bc	60	SF					
	a	23	4					
Acetic Acid	a	20	SF					
	a	60	SF					
	a	23	4					
Acetic Acid, <30%	a	25	GU					
	a	20	SL					
	a	60	SL					
	a	23	4					
				1	23	0.0	< 0.01	2
Acetic Acid, >70%	a	25	GU					
	a	20	SL					
	bc	60	SL					
				3	27	90.0	13.00	21
				5	27	90.0	0.81	21
				7	27	90.0	-0.43	21
Acetic Anhydride	a	20	SF					
	bc	60	SF					
	a	23	4					
Acetone	a	25	GU					
	bc	20	SL					
	bc	60	SL					
	a	20	SF					
	a	23	4					
Acetone, <30%				1	23	0.0	< 0.01	2
Acetophenone				3	27	90.0	43.50	21
				5	27	90.0	2.13	21
				7	27	90.0	-8.70	21
Acidic Steel Pickling Waste	bc	23	31					
Acrylonitrile	a	20	SF					
	a	60	SF					
Adipic Acid	a	20	SL					
	a	60	SL					
	a	23	4					
Allyl Alcohol	a	23	4					
Allyl Alcohol, >70%	a	20	SL					
	a	60	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA					
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value	(Exponent)	Reference
Aluminum Chloride	a	20	SL						
	a	60	SL						
	a	23	PH						
Aluminum Chloride, <30%	a	25	GU						
	a	23	PH						
Aluminum Fluoride	a	20	SL						
	a	60	SL						
	a	23	PH						
Aluminum Potassium Sulfate	a	20	SL						
	a	60	SL						
Aluminum Sulfate	a	20	SL						
	a	60	SL						
	a	23	PH						
	a	23	4						
Aluminum Sulfate, <30%	a	25	GU						
Ammonia	a	20	SL						
	a	60	SL						
	a	23	4						
Ammonia, <30%	a	20	SL						
	a	60	SL						
Ammonium Chloride	a	20	SL						
	a	60	SL						
	a	23	PH						
	a	23	4						
Ammonium Chloride, <30%	a	25	GU						
Ammonium Fluoride	a	20	SL						
	a	60	SL						
	a	23	PH						
	a	23	4						
Ammonium Hydroxide	a	20	SF						
	a	23	4						
Ammonium Hydroxide, <30%	a	25	GU						
				3	27	90.0	< 0.01		21
				5	27	90.0	0.02		21
				7	27	90.0	0.87		21
Ammonium Hydroxide, >70%	a	25	GU						
Ammonium Nitrate	a	20	SL						
	a	60	SL						
Ammonium Nitrate, <30%	a	25	GU						
Ammonium Phosphate, <30%	a	25	GU						

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Ammonium Sulfate	a	20	SL					
	a	60	SL					
	a	23	PH					
Ammonium Sulfide	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Amyl Acetate	a	25	GU					
	a	20	SL					
	bc	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	4					
				3	27	90.0	104.30	21
				5	27	90.0	3.31	21
				7	27	90.0	-10.60	21
Amyl Alcohol	a	20	SL					
	bc	60	SL					
Aniline	a	25	GU					
	a	20	SL					
	bc	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	PH					
	a	23	4					
				3	27	90.0	4.30	21
				5	27	90.0	0.76	21
				7	27	90.0	-1.70	21
Antimony Pentachloride	a	23	4					
Antimony Trichloride, >70%	a	20	SL					
	a	60	SL					
Arsenic Acid	a	20	SL					
	a	60	SL					
Barium Chloride, <30%	a	25	GU					
Barium Chloride	a	20	SL					
	a	60	SL					
	a	23	PH					
Barium Hydroxide	a	25	GU					
	a	20	SL					
	a	60	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Barium Sulfate	a	20	SL					
	a	60	SL					
	a	23	PH					
Barium Sulfide	a	20	SL					
	a	60	SL					
	a	23	PH					
Barium Sulfide, <30%	a	25	GU					
Barium Carbonate	a	20	SL					
	a	60	SL					
	a	23	PH					
Base Solutions	a	23	14					
Benzaldehyde	a	25	GU					
	a	20	SL					
	bc	60	SL					
	a	20	SF					
	bc	60	SF					
	a	23	4					
				3	27	90.0	17.60	21
				5	27	90.0	2.08	21
				7	27	90.0	-7.00	21
Benzene	bc	25	GU					
	bc	20	SL					
	bc	60	SL					
	bc	20	SF					
	d	60	SF					
	bc	23	4					
				3	27	90.0	4.30	21
				5	27	90.0	5.50	21
				7	27	90.0	-6.50	21
Benzoic Acid	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	4					
Benzyl Alcohol	a	25	GU					
	a	20	SF					
	a	60	SF					
Benzyl Chloride	d	25	GU					
	d	23	4					
Boric Acid	a	20	SL					
	a	60	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Boric Acid	a	23	PH					
Boric Acid, <30%	a	25	GU					
Brine	a	23	14					
Bromine	d	20	SL					
	d	60	SL					
	d	20	SF					
	d	60	SF					
	bc	23	PH					
Bromobenzene	d	25	GU					
Butane	a	20	SL					
	a	60	SL					
1-Butanol	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
Butyl Acetate	bc	23	PH					
	a	23	4					
n-Butyl Phthalate	a	20	SF					
	bc	60	SF					
	bc	23	4					
Butylamine	a	23	4					
1,3-Butylene Glycol	a	20	SF					
	a	60	SF					
Butyric Acid	a	20	SL					
	bc	60	SL					
	a	20	SF					
	bc	60	SF					
	a	23	4					
Calcium Carbonate	a	20	SL					
	a	60	SL					
	a	23	PH					
Calcium Chlorate	a	20	SL					
	a	60	SL					
	a	23	PH					
Calcium Chloride	a	20	SL					
	a	60	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Calcium Chloride, <30%	a	25	GU					
Calcium Hydroxide	a	25	GU					
	a	20	SL					
	a	60	SL					
	a	23	4					
Calcium Hypochlorite	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	23	PH					
	a	23	4					
Calcium Hypochlorite, <30%	a	25	GU					
Calcium Nitrate	a	20	SL					
	a	60	SL					
	a	23	PH					
Calcium Sulfate	a	20	SL					
	a	60	SL					
	a	23	PH					
Calcium Sulfide, <30%	bc	20	SL					
	bc	60	SL					
Carbon Disulfide	bc	25	GU					
	bc	20	SL					
	d	60	SL					
	bc	20	SF					
	d	60	SF					
	d	23	4					
Carbon Tetrachloride	bc	25	GU					
	bc	20	SL					
	d	60	SL					
	bc	20	SF					
	d	60	SF					
	d	23	4					
				1	23	0.0	1.46	2
				3	27	90.0	47.80	21
				5	27	90.0	14.00	21
				7	27	90.0	-11.50	21
Caustic Petroleum Sludge	a	23	31					
Chlorine	bc	20	SL					
	d	60	SL					
	d	20	SF					
	d	60	SF					
	bc	23	PH					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Chlorine	d	23	4					
Chlorine, <30%				3	27	90.0	1.10	21
				5	27	90.0	0.01	21
				7	27	90.0	-1.00	21
Chlorobenzene	bc	20	SF					
	d	60	SF					
	d	23	4					
				1	23	0.0	1.21	2
				1	23	0.0	0.54	2
				3	27	90.0	34.80	21
				5	27	90.0	5.33	21
				7	27	90.0	-6.90	21
Chloroform	d	25	GU					
	d	20	SL					
	d	60	SL					
	bc	20	SF					
	d	60	SF					
	d	23	4					
				1	23	0.0	2.17	2
Chlorosulfonic Acid	d	20	SF					
	d	60	SF					
	a	23	PH					
	d	23	4					
Chlorosulfonic Acid, <30%	d	25	GU					
Chromic Acid	bc	23	4					
Chromic Acid, <30%	a	25	GU					
	a	20	SL					
	bc	60	SL					
				3	27	90.0	< 0.01	21
				5	27	90.0	-0.55	21
				7	27	90.0	0.15	21
Chromic Acid, 30-70%	a	20	SL					
	bc	60	SL					
	a	20	SF					
	d	60	SF					
	a	23	PH					
Chromic Acid, >70%	bc	25	GU					
Citric Acid	a	20	SL					
	a	60	SL					
Citric Acid, <30%	a	25	GU					
Cresols	a	20	SF					
	bc	60	SF					
	a	23	4					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Crotonaldehyde	a	23	4					
Cupric Chloride	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Cupric Chloride, <30%	a	25	GU					
Cupric Nitrate	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Cupric Sulfate	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Cupric Sulfate, <30%	a	25	GU					
Cyclohexane	a	25	GU					
	a	20	SF					
	bc	60	SF					
	bc	23	4					
				3	27	90.0	95.70	21
				5	27	90.0	6.52	21
				7	27	90.0	-14.30	21
Cyclohexanol	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
Cyclohexanone	a	20	SL					
	bc	60	SL					
	a	20	SF					
	bc	60	SF					
	d	23	PH					
Decahydronaphthalene	a	20	SL					
	bc	60	SL					
	a	20	SF					
	d	60	SF					
Dibenzyl Ether	bc	25	GU					
Dichlorobenzene	d	23	4					
Dichloroethylene (all isomers)	d	20	SF					
	d	60	SF					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Dichloropropane (all isomers)	d	23	4					
Dichloropropane-Dichloropropene	d	23	4					
Dichloropropene(s)	d	23	4					
Diethylamine	a	23	4					
Diethylene Glycol Monobutyl Ethe	bc	25	GU					
Dimethylamine	bc	20	SF					
	d	60	SF					
	a	23	4					
Dimethylformamide	a	20	SF					
	a	60	SF					
	a	23	4					
Di-n-octyl Phthalate	a	25	GU					
	a	20	SL					
	bc	60	SL					
1,4-Dioxane	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
Domestic Sewage	a	23	14					
Electroplating Sludge	bc	23	31					
Ethanol	a	25	GU					
	a	20	SF					
	a	60	SF					
				3	27	90.0	17.40	21
				5	27	90.0	0.26	21
				7	27	90.0	-0.43	21
Ethanol, 30-70%	a	20	SL					
	bc	60	SL					
Ethyl Acetate	a	25	GU					
	a	20	SL					
	d	60	SL					
	a	20	SF					
	bc	60	SF					
				3	27	90.0	95.70	21
				5	27	90.0	2.23	21
				7	27	90.0	-7.40	21
Ethyl Ether	bc	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Ethyl Ether	bc	20	SL					
	bc	20	SF					
	a	23	4					
				3	27	90.0	113.00	21
				5	27	90.0	3.07	21
				7	27	90.0	-8.80	21
Ethylamine	a	23	4					
Ethyl Benzene	bc	25	GU					
	bc	23	4					
Ethylene Glycol Monoethyl Ether	bc	25	GU					
Ethylenediamine	a	20	SF					
	a	60	SF					
	a	23	4					
Ethylene Dibromide	a	23	4					
Ethylene Dichloride	d	25	GU					
	bc	20	SF					
	d	60	SF					
	d	23	4					
Ethylene Glycol	a	25	GU					
	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	4					
				3	27	90.0	-4.30	21
				5	27	90.0	0.01	21
				7	27	90.0	-1.80	21
Ferric Chloride	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Ferric Chloride, <30%	a	25	GU					
Ferric Nitrate	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Ferric Nitrate, <30%	a	25	GU					
Ferric Sulfate	a	20	SL					
	a	60	SL					
	a	23	4					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Ferrous Chloride	a	20	SL					
	a	60	SL					
	a	23	PH					
Ferrous Sulfate	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Ferrous Sulfate, <30%	a	25	GU					
Fluoboric Acid	a	23	PH					
Fluorine	d	20	SL					
	d	60	SL					
	d	20	SF					
	d	60	SF					
	a	23	PH					
Fluosilicic Acid	a	23	PH					
Fluosilicic Acid, 30-70%	a	20	SL					
	a	60	SL					
Formaldehyde, <37%	a	20	SL					
	a	60	SL					
	a	20	SF					
	bc	60	SF					
	a	23	4					
Formic Acid	a	23	PH					
	a	23	4					
Formic Acid, <30%	a	25	GU					
Formic Acid, 30-70%	a	20	SL					
	a	60	SL					
Formic Acid, >70%	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
Furfural	a	25	GU					
	a	23	4					
Furfuryl Alcohol	a	20	SL					
	bc	60	SL					
	a	20	SF					
	bc	60	SF					
Gasoline	a	20	SL					
	bc	60	SL					
	a	20	SF					
	bc	60	SF					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

Chemical	RATINGS Rating	 Deg C	 Reference	CHEMICAL RESISTANCE DATA Test	 Deg C	 Days	 Test Value (Exponent)	 Reference
Glucose	a	20	SL					
	a	60	SL					
Glycerol	a	25	GU					
	a	20	SF					
	a	60	SF					
Heptane	bc	25	GU					
	a	20	SL					
	d	60	SL					
	a	20	SF					
	bc	60	SF					
	bc	23	4					
				3	27	90.0	95.70	21
				5	27	90.0	4.99	21
				7	27	90.0	-10.80	21
Hexane	bc	25	GU					
	a	20	SF					
	bc	60	SF					
1-Hexanol	a	25	GU					
Hydrobromic Acid, 30-70%	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	PH					
Hydrobromic Acid, >70%	a	20	SL					
	a	60	SL					
Hydrochloric Acid	a	23	4					
Hydrochloric Acid, >70%	a	25	GU					
	a	20	SL					
	a	60	SL					
Hydrochloric Acid, <30%	a	25	GU					
	a	20	SL					
	a	60	SL					
	a	23	PH					
Hydrocloric Acid, 30-70%				3	27	90.0	-4.30	21
				5	27	90.0	0.04	21
				7	27	90.0	-0.43	21
Hydrocyanic Acid	a	23	PH					
Hydrocyanic Acid, <30%	a	20	SL					
	a	60	SL					
Hydrofluoric Acid, <30%	a	20	SL					
	a	60	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Hydrofluoric Acid	a	23	4					
Hydrofluoric Acid, 30-70%	a	20	SL					
	bc	60	SL					
	a	20	SF					
	bc	60	SF					
	a	23	PH					
				3	27	90.0	13.00	21
				5	27	90.0	0.01	21
				7	27	90.0	-3.10	21
Hydrofluoric Acid, >70%	a	25	GU					
Hydrogen	a	20	SL					
	a	60	SL					
	a	23	PH					
Hydrogen Peroxide, <30%	a	20	SF					
	a	60	SF					
	a	23	PH					
Hydrogen Peroxide, 30-70%	a	20	SL					
	a	60	SL					
				3	27	90.0	8.70	21
				5	27	90.0	0.01	21
				7	27	90.0	-3.40	21
Hydrogen Peroxide, >70%	a	20	SL					
	d	60	SL					
	a	20	SF					
	d	60	SF					
	a	23	PH					
Hydrogen Sulfide	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	PH					
Hydroquinone	a	20	SL					
	a	60	SL					
	a	23	PH					
Isooctane	a	20	SF					
	bc	60	SF					
Isoprene	bc	23	4					
Isopropyl Alcohol	a	25	GU					
	a	20	SF					
	a	60	SF					
	a	23	4					
Isopropyl Ether	a	20	SF					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Isopropyl Ether	bc	60	SF					
Lactic Acid	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
Lactic Acid, <30%	a	25	GU					
Lead Acetate	a	20	SL					
	a	23	PH					
	a	23	4					
Magnesium Chloride	a	20	SL					
	a	60	SL					
	a	23	PH					
Magnesium Chloride, <30%	a	25	GU					
Magnesium Hydroxide	a	20	SL					
	a	60	SL					
	a	23	PH					
Magnesium Nitrate	a	20	SL					
	a	60	SL					
	a	23	PH					
Magnesium Sulphate	a	23	PH					
Magnesium Sulphate, <30%	a	25	GU					
Maleic Acid	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	4					
Mercuric Chloride	a	20	SL					
	a	60	SL					
	a	23	PH					
Mercuric Cyanide	a	20	SL					
	a	60	SL					
	a	23	PH					
Mercuric Nitrate	a	20	SL					
	a	60	SL					
	a	23	4					
Mercury	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA					
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value	(Exponent)	Reference
Methanol	a	20	SL						
	a	60	SL						
	a	20	SF						
	bc	60	SF						
Methanol, <30%	a	25	GU	1	23	0.0	< 0.01		2
Methylamine	a	23	4						
Methyl Bromide	bc	23	PH						
Methylene Chloride	bc	20	SL						
	d	20	SF						
	d	60	SF						
	a	23	PH						
Methyl Ethyl Ketone	a	25	GU						
	a	20	SF						
	bc	60	SF						
	d	23	PH						
Methyl Isobutyl Ketone	a	25	GU						
Methyl Methacrylate	a	23	4						
Mild Acids	a	23	14						
Napthalene	a	25	GU						
	d	23	4						
Nickel Chloride	a	20	SL						
	a	60	SL						
	a	23	PH						
	a	23	4						
Nickel Nitrate	a	20	SL						
	a	60	SL						
	a	23	PH						
	a	23	4						
Nickel Sulfate	a	20	SL						
	a	60	SL						
	a	23	PH						
	a	23	4						
Nickel Sulfate, <30%	a	25	GU						
Nitric Acid	bc	23	4						
Nitric Acid, <30%	a	25	GU						
	a	20	SL						
	a	60	SL						

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Nitric Acid, <30%	a	20	SF					
	a	60	SF					
Nitric Acid, 30-70%	a	20	SL					
	d	60	SL					
	bc	20	SF					
	d	60	SF					
	a	23	PH					
				3	27	90.0	-13.00	21
				5	27	90.0	1.09	21
				7	27	90.0	1.50	21
Nitric Acid, >70%	d	20	SL					
	d	60	SL					
	d	20	SF					
	d	60	SF					
Nitrobenzene	a	25	GU					
	a	20	SF					
	bc	60	SF					
	d	23	PH					
	a	23	4					
				3	27	90.0	30.40	21
				5	27	90.0	2.25	21
				7	27	90.0	-3.85	21
Nitrohydrochoric Acid	bc	20	SL					
	bc	60	SL					
Nitrotoluene	a	23	4					
Oil Refinery Sludge	bc	23	31					
Oily-Aromatic Oil	bc	23	14					
Oleic Acid	a	20	SL					
	bc	60	SL					
	a	20	SF					
	bc	60	SF					
Oleic Acid, >70%	a	25	GU					
Oxalic Acid	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	PH					
Oxalic Acid, <30%	a	25	GU					
Oxidizing Acids	d	23	14					
Oxygen	a	20	SL					
	bc	60	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Pentachlorophenol	d	23	4					
Perchloric Acid, <30%	a	20	SF					
	a	60	SF					
Perchloric Acid, 30-70%	a	20	SF					
	bc	60	SF					
Petroleum Oil - No Aromatics	a	23	14					
Phenol	a	20	SL					
	a	60	SL					
	a	20	SF					
	bc	60	SF					
	a	23	4					
				3	27	90.0	4.30	21
				5	27	90.0	2.70	21
				7	27	90.0	-0.15	21
Phenol, <30%	bc	25	GU					
Phenol, >70%	a	25	GU					
Phosgene	d	23	4					
Phosphoric Acid	a	23	4					
Phosphoric Acid, <30%	a	23	PH					
Phosphoric Acid, 30-70%	a	20	SL					
	a	60	SL					
Phosphoric Acid, >70%	a	25	GU					
	a	20	SL					
	bc	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	PH					
				3	27	90.0	< 0.01	21
				5	27	90.0	< 0.01	21
				7	27	90.0	-0.37	21
Phosphorus Trichloride	a	20	SL					
	bc	60	SL					
	bc	20	SF					
	bc	60	SF					
Picric Acid	a	20	SL					
Picric Acid, <30%	a	25	GU					
Polychlorinated Biphenyls (PCBs)	d	23	4					
Potassium Bicarbonate	a	20	SL					
	a	60	SL					
	a	23	PH					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Potassium Bisulfate	a	20	SL					
	a	60	SL					
Potassium Bisulfide	a	20	SL					
	a	60	SL					
Potassium Bromate	a	20	SL					
	a	60	SL					
	a	23	PH					
Potassium Bromide	a	20	SL					
	a	60	SL					
	a	23	PH					
Potassium Carbonate	a	20	SL					
	a	60	SL					
	a	23	PH					
Potassium Chlorate	a	20	SL					
	a	60	SL					
	a	23	PH					
Potassium Chloride	a	20	SL					
	a	60	SL					
	a	23	PH					
Potassium Chloride, <30%	a	25	GU					
Potassium Chromate	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Potassium Cyanide	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Potassium Dichromate	a	20	SL					
	a	60	SL					
Potassium Dichromate, <30%	a	25	GU					
Potassium Ferricyanide	a	20	SL					
	a	60	SL					
Potassium Ferrocyanide	a	20	SL					
	a	60	SL					
Potassium Fluoride	a	20	SL					
	a	60	SL					
	a	23	PH					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Potassium Hydroxide	a	23	4					
Potassium Hydroxide, <30%	a	25	GU					
	a	20	SL					
	a	60	SL					
Potassium Hydroxide, 30-70%	a	20	SL					
	a	60	SL					
Potassium Nitrate	a	20	SL					
	a	60	SL					
	a	23	PH					
Potassium Perchlorate	a	20	SL					
	a	60	SL					
	a	23	PH					
Potassium Permanganate, <30%	a	25	GU					
	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	PH					
Potassium Persulfate	a	20	SL					
	a	60	SL					
	a	23	PH					
Potassium Sulfate	a	20	SL					
	a	60	SL					
	a	23	PH					
Potassium Sulfite	a	20	SL					
	a	60	SL					
	a	23	PH					
Propionic Acid	a	20	SF					
	bc	60	SF					
	a	23	4					
Propionic Acid, 30-70%	a	20	SL					
	a	60	SL					
Propionic Acid, >70%	a	20	SL					
	bc	60	SL					
Propionic Anhydride	a	23	4					
Propyl Alcohol	a	20	SF					
	a	60	SF					
Propylene Oxide	a	23	4					
Pyridine	a	20	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Pyridine	bc	60	SL					
	a	20	SF					
	bc	60	SF					
Resorcinol	a	25	GU					
	a	23	4					
Rubber and Plastic Waste	a	23	31					
Salicylic Acid	a	20	SL					
	a	60	SL					
Salt Solutions	a	23	14					
Silver Acetate	a	20	SL					
	a	60	SL					
Silver Cyanide	a	20	SL					
	a	60	SL					
Silver Nitrate	a	20	SL					
	a	60	SL					
	a	23	4					
Sodium Benzoate	a	20	SL					
	a	60	SL					
	a	23	PH					
Sodium Bicarbonate	a	20	SL					
	a	60	SL					
Sodium Bicarbonate, <30%	a	25	GU					
Sodium Biphosphate	a	20	SL					
	a	60	SL					
Sodium Bisulfite	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Sodium Borate	a	20	SL					
	a	60	SL					
	a	23	PH					
Sodium Borate, <30%	a	25	GU					
Sodium Bromide	a	20	SL					
	a	60	SL					
Sodium Carbonate	a	20	SL					
	a	60	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Sodium Carbonate	a	23	PH					
Sodium Chlorate	a	20	SL					
	a	60	SL					
	a	23	PH					
Sodium Chloride	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Sodium Chloride, <30%	a	25	GU					
Sodium Cyanide	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Sodium Ferriccyanide	a	20	SL					
	a	60	SL					
	a	23	PH					
Sodium Ferrocyanide	a	20	SL					
	a	60	SL					
	a	23	PH					
Sodium Fluoride	a	20	SL					
	a	60	SL					
	a	23	PH					
	a	23	4					
Sodium Hydroxide, <30%	a	25	GU					
	a	23	4					
Sodium Hydroxide, 30-70%	a	20	SL					
	a	60	SL					
				3	27	90.0	4.30	21
				5	27	90.0	0.07	21
				7	27	90.0	-0.28	21
Sodium Hydroxide, >70%	a	25	GU					
	a	20	SL					
	a	60	SL					
Sodium Hypochlorite, <30%	a	20	SF					
	bc	60	SF					
	a	23	PH					
Sodium Nitrate	a	20	SL					
	a	60	SL					
	a	23	PH					
Sodium Nitrite	a	20	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Sodium Nitrite	a	60	SL					
	a	23	4					
Sodium Sulfate	a	20	SL					
	a	60	SL					
	a	23	PH					
Sodium Sulfide	a	20	SL					
	a	60	SL					
	a	23	PH					
Stannous Chloride	a	23	PH					
Stearic Acid	a	25	GU					
	a	20	SF					
	bc	60	SF					
Styrene	bc	23	4					
Sulfur Dioxide	a	20	SL					
	a	60	SL					
Sulfur Trioxide	d	20	SL					
	d	60	SL					
Sulfuric Acid, <30%	a	25	GU					
	a	20	SL					
	a	60	SL					
Sulfuric Acid, 30-70%	a	20	SL					
	a	60	SL					
	a	20	SF					
	bc	60	SF					
	a	23	PH					
				3	27	90.0	-4.30	21
				5	27	90.0	-0.01	21
				7	27	90.0	-2.60	21
Sulfuric Acid, >70%	bc	25	GU					
	a	20	SL					
	d	60	SL					
	bc	20	SF					
	d	60	SF					
	bc	23	PH					
Sulfurous Acid	a	23	PH					
Sulfurous Acid, 30-70%	a	20	SL					
	a	60	SL					
Tannic Acid	a	25	GU					
	a	20	SL					
	a	60	SL					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Tannic Acid, <30%	a	20	SF					
	a	60	SF					
	a	23	PH					
L-Tartaric Acid	a	25	GU					
	a	20	SL					
	a	60	SL					
Tetrachloroethylene	d	25	GU					
	d	23	4					
				1	23	0.0	2.50	2
				1	23	0.0	1.58	2
				1	23	0.0	0.83	2
				1	23	0.0	1.71	2
				1	23	0.0	0.92	2
				3	27	90.0	74.00	21
				5	27	90.0	8.59	21
				7	27	90.0	-10.70	21
Tetrahydrofuran	bc	20	SF					
	d	60	SF					
	bc	23	PH					
				1	23	0.0	1.00	2
Thionyl Chloride	bc	20	SL					
	d	60	SL					
	d	20	SF					
Thiophene	bc	20	SF					
	bc	60	SF					
Toluene	bc	25	GU					
	bc	20	SL					
	d	60	SL					
				1	23	0.0	1.67	2
				1	23	0.0	0.79	2
				1	23	0.0	0.42	2
				1	23	0.0	0.75	2
				1	23	0.0	0.54	2
				3	27	90.0	56.50	21
				5	27	90.0	4.40	21
				7	27	90.0	11.80	21
Toluene, <30%				1	23	0.0	0.08	2
Toxic Pesticide Formulations	a	23	31					
Toxic Pharmaceutical Waste	a	23	31					
Tributyl Phosphate				3	23	523.0	1.00	33
				7	23	523.0	-12.00	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Tributyl Phosphate				8	23	523.0	-8.00	33
				9	23	523.0	-1.00	33
Trichloroethylene	bc	20	SF					
	d	60	SF					
	d	23	4					
				1	23	0.0	6.25	2
				1	23	0.0	3.85	2
				1	23	0.0	1.96	2
				1	23	0.0	4.54	2
				1	23	0.0	3.38	2
				1	23	0.0	0.25	2
Trichloroethylene, <30%								
Tricresyl Phosphate	a	25	GU					
Triethanolamine	a	25	GU					
	a	20	SF					
	a	60	SF					
Triethylamine	a	20	SL					
	bc	60	SL					
	a	23	4					
Trimethylamine	a	23	4					
Turpentine				3	27	90.0	152.20	21
				5	27	90.0	6.65	21
				7	27	90.0	-13.60	21
Urea	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	PH					
Vinyl Acetate	bc	23	4					
Vinylidene Chloride	a	23	4					
Water	a	20	SL					
	a	60	SL					
	a	20	SF					
	a	60	SF					
	a	23	4					
	a	23	14					
				1	23	0.0	< 0.01	12
				1	23	0.0	< 0.01	12
				3	27	90.0	8.70	21
				5	27	90.0	0.02	21
				7	27	90.0	-1.50	21

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE

Chemical	RATINGS Rating	 Deg C	 Reference	CHEMICAL RESISTANCE DATA Test	 Deg C	 Days	 Test Value	 (Exponent)	 Reference
Xylene	bc	25	GU						
	bc	20	SL						
	bc	60	SL						
	d	23	PH						
	bc	23	4						
				1	23	0.0	1.33		2
				1	23	0.0	0.67		2
				1	23	0.0	0.38		2
				1	23	0.0	0.50		2
				1	23	0.0	0.38		2
				3	27	90.0	113.00		21
				5	27	90.0	5.29		21
				7	27	90.0	-13.30		21
Xylene, <30%				1	23	0.0	0.07		2
Zinc Chloride	a	20	SL						
	a	60	SL						
	a	23	PH						
	a	23	4						
Zinc Nitrate	a	23	4						
Zinc Nitrate, <30%	a	25	GU						
Zinc Oxide	a	20	SL						
	a	60	SL						
Zinc Sulfate	a	20	SL						
	a	60	SL						
	a	23	PH						
	a	23	4						

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE / EPDM ALLOY

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetic Acid, <30%	a	25	GU					
Acetic Acid, >70%	bc	25	GU					
Acetone	a	25	GU					
Alkaline-Spent Caustic				5	23	780.0	0.60	33
Aluminum Chloride, <30%	a	25	GU					
Aluminum Sulfate, <30%	a	25	GU					
Ammonium Chloride, <30%	a	25	GU					
Ammonium Hydroxide, <30%	a	25	GU					
Ammonium Hydroxide, >70%	a	25	GU					
Ammonium Nitrate, <30%	a	25	GU					
Ammonium Phosphate, <30%	a	25	GU					
Amyl Acetate	bc	25	GU					
Aniline	a	25	GU					
Barium Chloride, <30%	a	25	GU					
Barium Hydroxide	a	25	GU					
Barium Sulfide, <30%	a	25	GU					
Benzaldehyde	bc	25	GU					
Benzene	d	25	GU					
Benzyl Alcohol	bc	25	GU					
Benzyl Chloride	d	25	GU					
Boric Acid, <30%	a	25	GU					
Bromobenzene	d	25	GU					
Calcium Chloride, <30%	a	25	GU					
Calcium Hydroxide	a	25	GU					
Calcium Hypochlorite, <30%	a	25	GU					
Carbon Disulfide	d	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE / EPDM ALLOY

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Carbon Tetrachloride	d	25	GU					
Chloroform	d	25	GU					
Chlorosulfonic Acid, <30%	d	25	GU					
Chromic Acid, <30%	bc	25	GU					
Chromic Acid, >70%	d	25	GU					
Citric Acid, <30%	a	25	GU					
Cupric Chloride, <30%	a	25	GU					
Cupric Sulfate, <30%	a	25	GU					
Cyclohexane	d	25	GU					
Dibenzyl Ether	bc	25	GU					
Diethylene Glycol Monobutyl Ethe	bc	25	GU					
Di-n-octyl Phthalate	bc	25	GU					
Ethanol	a	25	GU					
Ethyl Acetate	bc	25	GU					
Ethyl Ether	d	25	GU					
Ethyl Benzene	d	25	GU					
Ethylene Glycol Monoethyl Ether	bc	25	GU					
Ethylene Dichloride	d	25	GU					
Ethylene Glycol	a	25	GU					
Ferric Chloride, <30%	a	25	GU					
Ferric Nitrate, <30%	a	25	GU					
Ferrous Sulfate, <30%	a	25	GU					
Formic Acid, <30%	a	25	GU					
Furfural	a	25	GU					
Glycerol	a	25	GU					
Heptane	d	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE / EPDM ALLOY

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Hexane	d	25	GU					
1-Hexanol	a	25	GU					
Hydrochloric Acid, >70%	a	25	GU					
Hydrochloric Acid, <30%	a	25	GU					
Hydrofluoric Acid				5	23	761.0	1.10	33
Hydrofluoric Acid, >70%	a	25	GU					
Isopropyl Alcohol	a	25	GU					
Lactic Acid, <30%	a	25	GU					
Lead-Low Lead Gasoline Washwater				3	23	1340.0	6.00	33
				5	23	786.0	17.00	33
				8	23	1340.0	10.00	33
Magnesium Chloride, <30%	a	25	GU					
Magnesium Sulphate, <30%	a	25	GU					
Methanol, <30%	a	25	GU					
Methyl Ethyl Ketone	a	25	GU					
Methyl Isobutyl Ketone	a	25	GU					
Municipal Solid Waste				10	23	243.0	-1.00	33
				10	23	578.0	3.00	33
				10	23	943.0	7.00	33
Napthalene	d	25	GU					
Nickel Sulfate, <30%	a	25	GU					
Nitric Acid				3	23	1220.0	-4.00	33
				5	23	751.0	7.60	33
				8	23	1220.0	3.00	33
Nitric Acid, <30%	a	25	GU					
Nitrobenzene	bc	25	GU					
Oily-Aromatic Oil				5	23	761.0	29.40	33
Oily-Oil Pond 104				5	23	752.0	26.50	33
Oily-Weed Oil				5	23	809.0	38.10	33
Oleic Acid, >70%	bc	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HIGH DENSITY POLYETHYLENE / EPDM ALLOY

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Oxalic Acid, <30%	a	25	GU					
Pesticide - Weed Killer				5	23	807.0	0.50	33
Phenol, <30%	bc	25	GU					
Phenol, >70%	bc	25	GU					
Phosphoric Acid, >70%	a	25	GU					
Picric Acid, <30%	bc	25	GU					
Potassium Chloride, <30%	a	25	GU					
Potassium Dichromate, <30%	a	25	GU					
Potassium Hydroxide, <30%	a	25	GU					
Potassium Permanganate, <30%	a	25	GU					
Resorcinol	a	25	GU					
Sodium Bicarbonate, <30%	a	25	GU					
Sodium Borate, <30%	a	25	GU					
Sodium Chloride, <30%	a	25	GU					
Sodium Hydroxide, <30%	a	25	GU					
Sodium Hydroxide, >70%	a	25	GU					
Stearic Acid	bc	25	GU					
Sulfuric Acid, <30%	a	25	GU					
Sulfuric Acid, >70%	bc	25	GU					
Tannic Acid	a	25	GU					
L-Tartaric Acid	a	25	GU					
Tetrachloroethylene	d	25	GU					
Toluene	d	25	GU					
Tricresyl Phosphate	bc	25	GU					
Triethanolamine	a	25	GU					
Xylene	d	25	GU					
Zinc Nitrate, <30%	a	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: HYDRAULIC ASPHALT CONCRETE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA					
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value	(Exponent)	Reference
Simulated Landfill				11	23	1703.0	< 1.00	(-9)	33
				11	23	365.0	3.50	(-9)	33
				11	23	365.0	< 3.00	(-10)	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ISOBUTENE-ISOPRENE COPOLYMER (BUTYL RUBBER)

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acidic Steel Pickling Waste	a	23	31					
Alkaline-Spent Caustic				3	23	1250.0	42.00	33
				5	23	780.0	0.80	33
Base Solutions	a	23	14					
Brine	a	23	14					
Caustic Petroleum Sludge	a	23	31					
Domestic Sewage	a	23	14					
Electroplating Sludge	a	23	31					
Ethanol, >70%				3	23	7.0	-10.30	31
				3	23	28.0	-10.70	31
				7	23	7.0	-15.50	31
				7	23	28.0	-18.00	31
				8	23	7.0	-11.40	31
				8	23	28.0	-11.80	31
Hydrofluoric Acid				5	23	761.0	3.70	33
Lead-Low Lead Gasoline Washwater				3	23	1340.0	8.00	33
				5	23	786.0	28.70	33
Mild Acids	a	23	14					
Municipal Solid Waste				2	23	243.0	1.40	33
				2	23	578.0	2.60	33
				2	23	928.0	1.96	33
				3	23	365.0	3.00	33
				3	23	1703.0	1.00	33
				5	23	365.0	1.78	33
				5	23	365.0	2.32	33
				5	23	365.0	1.00	33
				7	23	365.0	-3.00	33
				7	23	1703.0	2.00	33
				9	23	365.0	-0.50	33
				9	23	1703.0	0.00	33
				10	23	365.0	-1.00	33
				10	23	1703.0	8.00	33
				10	23	243.0	-14.00	33
				10	23	578.0	-10.00	33
				10	23	943.0	-2.00	33
Nitric Acid				3	23	1220.0	319.00	33
				5	23	751.0	3.80	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: ISOBUTENE-ISOPRENE COPOLYMER (BUTYL RUBBER)

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Oil Refinery Sludge	d	23	31					
Oily-Aromatic Oil	d	23	14	5	23	761.0	31.20	33
Oily-Oil Pond 104				5	23	752.0	103.90	33
Oily-Weed Oil				5	23	809.0	64.20	33
Oxidizing Acids	d	23	14					
Pesticide - Weed Killer				3	23	1260.0	-23.00	33
				5	23	807.0	1.60	33
Petroleum Oil - No Aromatics	d	23	14					
Rubber and Plastic Waste	a	23	31					
Salt Solutions	a	23	14					
Toxic Pesticide Formulations	bc	23	31					
Toxic Pharmaceutical Waste	bc	23	31					
Tributyl Phosphate				3	23	523.0	15.00	33
				7	23	523.0	7.00	33
				8	23	523.0	-26.00	33
				9	23	523.0	-2.00	33
Water	a	23	14	1	23	0.0	0.02	12
				1	23	0.0	< 0.01	12
				1	23	0.0	< 0.01	12
				5	23	365.0	1.60	33
				5	23	365.0	1.70	33
				5	23	365.0	1.10	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: LOW DENSITY POLYETHYLENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Municipal Solid Waste				2	23	243.0	< 0.01	33
				2	23	578.0	0.20	33
				2	23	928.0	0.10	33
				3	23	365.0	< 0.01	33
				3	23	1703.0	7.00	33
				5	23	365.0	0.25	33
				7	23	365.0	15.00	33
				7	23	1703.0	21.00	33
				10	23	365.0	-4.00	33
				10	23	1703.0	5.00	33
				10	23	243.0	6.00	33
				10	23	578.0	2.00	33
				10	23	943.0	6.00	33
Water				1	23	0.0	< 0.01	12
				5	23	365.0	0.25	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: LOW DENSITY POLYETHYLENE COPOLYMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetic Acid, <30%	a	25	GU					
Acetic Acid, >70%	bc	25	GU					
Acetone	d	25	GU					
Aluminum Chloride, <30%	a	25	GU					
Aluminum Sulfate, <30%	a	25	GU					
Ammonium Chloride, <30%	a	25	GU					
Ammonium Hydroxide, <30%	a	25	GU					
Ammonium Hydroxide, >70%	a	25	GU					
Ammonium Nitrate, <30%	a	25	GU					
Ammonium Phosphate, <30%	a	25	GU					
Amyl Acetate	d	25	GU					
Aniline	d	25	GU					
Barium Chloride, <30%	a	25	GU					
Barium Hydroxide	a	25	GU					
Barium Sulfide, <30%	a	25	GU					
Benzaldehyde	d	25	GU					
Benzene	d	25	GU					
Benzyl Alcohol	d	25	GU					
Benzyl Chloride	d	25	GU					
Boric Acid, <30%	a	25	GU					
Bromobenzene	d	25	GU					
Calcium Chloride, <30%	a	25	GU					
Calcium Hydroxide	a	25	GU					
Calcium Hypochlorite, <30%	a	25	GU					
Carbon Disulfide	d	25	GU					
Carbon Tetrachloride	d	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: LOW DENSITY POLYETHYLENE COPOLYMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Chloroform	d	25	GU					
Chlorosulfonic Acid, <30%	d	25	GU					
Chromic Acid, <30%	d	25	GU					
Chromic Acid, >70%	d	25	GU					
Citric Acid, <30%	a	25	GU					
Cupric Chloride, <30%	a	25	GU					
Cupric Sulfate, <30%	a	25	GU					
Cyclohexane	d	25	GU					
Dibenzyl Ether	d	25	GU					
Diethylene Glycol Monobutyl Ethe	d	25	GU					
Di-n-octyl Phthalate	bc	25	GU					
Ethanol	bc	25	GU					
Ethyl Acetate	bc	25	GU					
Ethyl Ether	d	25	GU					
Ethyl Benzene	d	25	GU					
Ethylene Glycol Monoethyl Ether	d	25	GU					
Ethylene Dichloride	d	25	GU					
Ethylene Glycol	a	25	GU					
Ferric Chloride, <30%	a	25	GU					
Ferric Nitrate, <30%	a	25	GU					
Ferrous Sulfate, <30%	a	25	GU					
Formic Acid, <30%	a	25	GU					
Furfural	d	25	GU					
Glycerol	a	25	GU					
Heptane	d	25	GU					
Hexane	d	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: LOW DENSITY POLYETHYLENE COPOLYMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
1-Hexanol	a	25	GU					
Hydrochloric Acid, >70%	bc	25	GU					
Hydrochloric Acid, <30%	a	25	GU					
Hydrofluoric Acid, >70%	bc	25	GU					
Isopropyl Alcohol	bc	25	GU					
Lactic Acid, <30%	a	25	GU					
Magnesium Chloride, <30%	a	25	GU					
Magnesium Sulphate, <30%	a	25	GU					
Methanol, <30%	bc	25	GU					
Methyl Ethyl Ketone	bc	25	GU					
Methyl Isobutyl Ketone	d	25	GU					
Napthalene	d	25	GU					
Nickel Sulfate, <30%	a	25	GU					
Nitric Acid, <30%	a	25	GU					
Nitrobenzene	d	25	GU					
Oleic Acid, >70%	d	25	GU					
Oxalic Acid, <30%	a	25	GU					
Phenol, <30%	a	25	GU					
Phenol, >70%	d	25	GU					
Phosphoric Acid, >70%	a	25	GU					
Picric Acid, <30%	a	25	GU					
Potassium Chloride, <30%	a	25	GU					
Potassium Dichromate, <30%	a	25	GU					
Potassium Hydroxide, <30%	a	25	GU					
Potassium Permanganate, <30%	a	25	GU					
Resorcinol	a	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: LOW DENSITY POLYETHYLENE COPOLYMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Sodium Bicarbonate, <30%	a	25	GU					
Sodium Borate, <30%	a	25	GU					
Sodium Chloride, <30%	a	25	GU					
Sodium Hydroxide, <30%	a	25	GU					
Sodium Hydroxide, >70%	a	25	GU					
Stearic Acid	a	25	GU					
Sulfuric Acid, <30%	a	25	GU					
Sulfuric Acid, >70%	bc	25	GU					
Tannic Acid	a	25	GU					
L-Tartaric Acid	a	25	GU					
Tetrachloroethylene	d	25	GU					
Toluene	d	25	GU					
Tricresyl Phosphate	bc	25	GU					
Triethanolamine	bc	25	GU					
Xylene	d	25	GU					
Zinc Nitrate, <30%	a	25	GU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYCHLOROPRENE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetic Acid, <30%	a	23	DU					
Acetic Acid, >70%	d	23	DU					
Acetic Anhydride	a	23	DU					
Acetone	bc	23	DU					
Alkaline-Spent Caustic				3	23	1250.0	-5.00	33
				5	23	780.0	1.50	33
				8	23	1250.0	-4.00	33
Aluminum Sulfate	a	70	DU					
Ammonia	a	23	DU					
Ammonium Hydroxide	a	70	DU					
Ammonium Sulfate	a	70	DU					
Amyl Acetate	d	23	DU					
Barium Hydroxide	a	70	DU					
Base Solutions	a	23	14					
Benzene	d	23	DU					
Boric Acid	a	70	DU					
Brine	a	23	14					
Butane	a	23	DU					
Butyraldehyde	d	23	DU					
Calcium Bisulfite	d	23	DU					
Calcium Chloride	a	23	DU					
Calcium Hydroxide	a	70	DU					
Calcium Hypochlorite	bc	23	DU					
Carbon Tetrachloride	d	23	DU					
Chlorine, <30%	d	23	DU					
Chromic Acid, <30%	d	23	DU					
Citric Acid	a	23	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYCHLOROPRENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Cyclohexane	d	23	DU					
Di-n-octyl Phthalate	d	23	DU					
Domestic Sewage	a	23	14					
Ethanol	a	70	DU					
Ethyl Acetate	d	23	DU					
Ethylene Glycol	a	70	DU					
Ferric Chloride	a	23	DU					
Formic Acid	a	23	DU					
Furfural	bc	23	DU					
Gasoline	bc	23	DU					
Glycerol	a	70	DU					
Hydrocloric Acid, 30-70%	a	23	DU					
Hydrocyanic Acid	a	23	DU					
Hydrofluoric Acid				5	23	761.0	12.00	33
Hydrofluoric Acid, 30-70%	a	23	DU					
Hydrofluoric Acid, >70%	bc	23	DU					
Hydrogen Sulfide	a	23	DU					
Isopropyl Alcohol	a	23	DU					
Kerosene	bc	23	DU					
Lactic Acid	a	23	DU					
Lead-Low Lead Gasoline Washwater				3	23	1340.0	-25.00	33
				5	23	786.0	59.10	33
				8	23	1340.0	-38.00	33
Magnesium Chloride	a	70	DU					
Magnesium Hydroxide	a	70	DU					
Methanol	a	70	DU					
Methylene Chloride	d	38	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYCHLOROPRENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Methyl Ethyl Ketone	d	23	DU					
Mild Acids	a	23	14					
Municipal Solid Waste				5	23	365.0	8.73	33
				10	23	243.0	-21.00	33
				10	23	243.0	< 0.01	33
				10	23	243.0	-7.00	33
				10	23	578.0	-23.00	33
				10	23	578.0	< 0.01	33
				10	23	578.0	-1.00	33
				10	23	943.0	-24.00	33
				10	23	943.0	-1.00	33
				10	23	943.0	15.00	33
Naphtha, V.M.& P	d	23	DU					
Nitric Acid				5	23	751.0	17.40	33
Nitric Acid, 30-70%	d	23	DU					
Nitrobenzene	d	23	DU					
Oily-Aromatic Oil	d	23	14					
				5	23	761.0	142.60	33
Oily-Oil Pond 104				5	23	752.0	26.30	33
Oily-Weed Oil				5	23	809.0	89.30	33
Oleic Acid	bc	23	DU					
Oxidizing Acids	bc	23	14					
Palmitic Acid	bc	70	DU					
Pesticide - Weed Killer				3	23	1260.0	-16.00	33
				5	23	807.0	11.40	33
				8	23	1260.0	-46.00	33
Phenol	d	23	DU					
Phosphoric Acid, >70%	bc	23	DU					
Picric Acid	a	23	DU					
Salt Solutions	a	23	14					
Sodium Borate	a	70	DU					
Sodium Hydroxide, <30%	a	23	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYCHLOROPRENE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Sulfuric Acid, 30-70%	a	70	DU					
Sulfuric Acid, >70%	d	23	DU					
Tannic Acid, <30%	a	23	DU					
Tetrachloroethylene	d	23	DU					
Toluene	d	23	DU					
Trichloroethylene	d	23	DU					
Triethanolamine	a	70	DU					
Turpentine	d	23	DU					
Water	a	23	14					
				1	23	0.0	0.01	12
				1	23	0.0	0.02	12
				1	23	0.0	0.02	12
				1	23	0.0	0.01	12
				5	23	365.0	22.70	33
Xylene	d	23	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYEPICHLOROHYDRIN

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetone				2	24	7.0	105.00	HE
				3	24	7.0	-61.00	HE
				7	24	7.0	-32.00	HE
				9	24	7.0	-19.00	HE
n-Butyl Phthalate				2	24	7.0	62.00	HE
				3	24	7.0	-44.00	HE
				7	24	7.0	-43.00	HE
				9	24	7.0	-31.00	HE
Chromic Acid, <30%	a	22	HE					
	bc	100	HE					
Ethyl Acetate				2	24	7.0	131.00	HE
				3	24	7.0	-50.00	HE
				7	24	7.0	-42.00	HE
				9	24	7.0	-18.00	HE
Ethylene Glycol				2	24	7.0	< 0.01	HE
				3	24	7.0	-11.00	HE
				7	24	7.0	< 0.01	HE
				8	24	7.0	20.00	HE
				9	24	7.0	2.00	HE
Hydrochloric Acid, <30%	a	22	HE					
	bc	100	HE					
Hydrocloric Acid, 30-70%	bc	22	HE					
	d	100	HE					
Kerosene				2	24	7.0	< 0.01	HE
				3	24	7.0	-17.00	HE
				7	24	7.0	4.00	HE
				8	24	7.0	14.00	HE
				9	24	7.0	1.00	HE
Methanol				2	24	7.0	8.00	HE
				3	24	7.0	-67.00	HE
				7	24	7.0	-8.00	HE
				8	24	7.0	13.00	HE
				9	24	7.0	-9.00	HE
Nitric Acid, <30%	a	22	HE					
	d	100	HE					
Nitric Acid, >70%	d	22	HE					
	d	100	HE					
Oleic Acid				2	24	7.0	< 0.01	HE
				3	24	7.0	< 0.01	HE
				7	24	7.0	-3.00	HE
				8	24	7.0	8.00	HE

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYEPICHLOROHYDRIN

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Oleic Acid				9	24	7.0	1.00	HE
Phosphoric Acid, <30%	a	22	HE					
	a	100	HE					
Phosphoric Acid, >70%	a	22	HE					
	a	100	HE					
Sodium Hydroxide, <30%	a	22	HE					
	a	100	HE					
Sodium Hydroxide, 30-70%	a	22	HE					
	bc	100	HE					
Sulfuric Acid, <30%	a	22	HE					
	a	100	HE					
Sulfuric Acid, >70%	a	22	HE					
	a	100	HE					
Tetrachloroethylene				2	24	7.0	11.00	HE
				3	24	7.0	-36.00	HE
				7	24	7.0	-7.00	HE
				8	24	7.0	27.00	HE
				9	24	7.0	-5.00	HE
Toluene				2	24	7.0	96.00	HE
				3	24	7.0	-50.00	HE
				7	24	7.0	-32.00	HE
				9	24	7.0	-17.00	HE
Turpentine				2	24	7.0	< 0.01	HE
				3	24	7.0	-8.00	HE
				7	24	7.0	-3.00	HE
				8	24	7.0	< 0.01	HE
				9	24	7.0	1.00	HE
Water				1	23	0.0	0.84	12
				1	23	0.0	0.06	12
				2	24	7.0	< 0.01	HE
				3	24	7.0	< 0.01	HE
				7	24	7.0	-1.00	HE
				8	24	7.0	6.00	HE
				9	24	7.0	-1.00	HE

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYESTER ELASTOMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetic Acid, <30%	a	22	DU					
Acetic Acid, >70%	a	22	DU					
	bc	38	DU					
Acetone	bc	22	DU					
Ammonium Chloride	a	22	DU					
Ammonium Sulfate	a	22	DU					
Amyl Acetate	bc	22	DU					
Amyl Alcohol	a	22	DU					
Aniline	d	22	DU					
Benzene	a	22	DU					
Boric Acid	a	22	DU					
Butane	a	22	DU					
Butyl Acetate	bc	22	DU					
Calcium Chloride	a	22	DU					
Calcium Hypochlorite	a	22	DU					
Carbon Disulfide	a	22	DU					
Carbon Tetrachloride	a	22	DU					
Chloroform	bc	22	DU					
Chlorosulfonic Acid	d	22	DU					
Citric Acid	a	22	DU					
Cupric Chloride	a	22	DU					
Cupric Sulfate	a	22	DU					
Cyclohexane	a	22	DU					
Di-n-octyl Phthalate	a	22	DU					
Ethanol	a	22	DU					
Ethyl Acetate	a	22	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYESTER ELASTOMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Ethylene Dichloride	bc	22	DU					
Ethylene Glycol	a	22	DU					
Ethylene Oxide	a	22	DU					
Formaldehyde, <37%	bc	22	DU					
Formic Acid	bc	22	DU					
Freon 11	a	22	DU					
Freon 12	a	22	DU					
Gasoline	a	22	DU					
Glycerol	a	22	DU					
Hexane	a	22	DU					
Hydrazine	d	22	DU					
Hydrochloric Acid, <30%	d	22	DU					
Hydrocloric Acid, 30-70%	bc	22	DU					
Hydrogen Sulfide	d	22	DU					
Isooctane	a	22	DU					
Isopropyl Alcohol	a	22	DU					
JP-4, Jet Fuel	a	22	DU					
Methanol	a	22	DU					
Methylene Chloride	d	22	DU					
Methyl Ethyl Ketone	a	22	DU					
Naphtha, V.M.& P	a	22	DU					
Napthalene	a	22	DU					
Nitric Acid, <30%	bc	22	DU					
Nitric Acid, 30-70%	d	22	DU					
Nitric Acid, >70%	d	22	DU					
Nitrobenzene	d	22	DU					
Oleic Acid	a	22	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYESTER ELASTOMER

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Palmitic Acid	a	22	DU					
Phenol	d	22	DU					
Potassium Hydroxide	a	22	DU					
Sodium Chloride	a	22	DU					
Sodium Hydroxide, <30%	a	22	DU					
Sodium Hydroxide, 30-70%	bc	22	DU					
Sulfuric Acid, <30%	a	22	DU					
Sulfuric Acid, >70%	d	22	DU					
Sulfurous Acid	bc	22	DU					
Tannic Acid, <30%	a	22	DU					
Tetrachloroethylene	bc	22	DU					
Tetrahydrofuran	a	22	DU					
Toluene	a	22	DU					
Trichloroethylene	bc	22	DU					
Triethanolamine	d	22	DU					
Water	a	70	DU					
	bc	100	DU					
Xylene	a	22	DU					
Zinc Chloride	a	22	DU					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

Chemical	RATINGS Rating	 Deg C	 Reference	CHEMICAL RESISTANCE DATA Test	 Deg C	 Days	 Test Value (Exponent)	 Reference
Acetic Acid, <30%	a	23	SF	1	23	0.0	< 0.01	2
				5	24	1.0	-0.10	WS
				5	24	7.0	-0.10	WS
				5	24	28.0	-0.10	WS
Acetic Acid, 30-70%	c	23	SF					
Acetic Acid, >70%	d	23	SF					
Acetone	d	23	SF					
Acetone, <30%				1	23	0.0	0.04	2
Acidic Steel Pickling Waste	bc	23	31					
Alkaline-Spent Caustic				3	23	1250.0	-5.00	33
				5	23	780.0	0.40	33
				5	23	780.0	-0.90	33
				5	23	780.0	1.10	33
				8	23	1250.0	70.00	33
Aluminum Chloride	a	23	SF					
Ammonium Chloride	a	23	SF					
Ammonium Hydroxide, <30%	a	23	SF					
Ammonium Nitrate	a	23	SF					
Ammonium Sulfate	a	23	SF					
Amyl Alcohol	c	23	SF					
Aniline, >70%	d	23	SF					
Barium Chloride	a	23	SF					
Base Solutions	a	23	14					
Benzaldehyde	d	23	SF					
Benzene	d	23	SF	5	24	1.0	> 1000.00	WS
Benzoic Acid	a	23	SF					
Boric Acid	a	23	SF					
Brine	a	23	14	3	23	760.0	-29.00	30
				7	23	760.0	18.30	30
				7	23	608.0	3.00	30

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Brine				7	23	608.0	1.40	30
Bromine	d	23	SF					
Butane	d	23	SF					
1-Butanol	d	23	SF					
Calcium Carbonate	a	23	SF					
Calcium Chloride	a	23	SF					
Calcium Nitrate	a	23	SF					
Carbon Disulfide	d	23	SF					
Carbon Tetrachloride	d	23	SF					
Carbon Tetrachloride, <30%				1	23	0.0	0.06	2
Caustic Petroleum Sludge	a	23	31					
Chlorine	bc	23	SF					
Chlorobenzene	d	23	SF					
Chloroform	d	23	SF					
Chloroform, <30%				1	23	0.0	2.21	2
Chlorosulfonic Acid	d	23	SF					
Citric Acid	a	23	SF					
Cresols	d	23	SF					
Cupric Chloride	a	23	SF					
Cyclohexane	d	23	SF					
Cyclohexanol	d	23	SF					
Cyclohexanone	d	23	SF					
Decahydronaphthalene	d	23	SF					
Dichloroethylene (all isomers)	d	23	SF					
Dimethylformamide	d	23	SF					
1,4-Dioxane	d	23	SF					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Domestic Sewage	a	23	14					
Electroplating Sludge	bc	23	31					
Ethanol, <30%	a	23	SF					
Ethanol, 30-70%	c	23	SF					
Ethanol, >70%	c	23	SF					
				3	23	7.0	12.40	31
				3	23	28.0	7.90	31
				7	23	7.0	-11.20	31
				7	23	28.0	-5.20	31
				8	23	7.0	-22.00	31
				8	23	28.0	-5.30	31
Ethyl Benzene	d	23	SF					
Ethylene Glycol				5	24	1.0	-0.40	WS
				5	24	7.0	-1.10	WS
				5	24	28.0	-1.20	WS
Ferric Chloride	d	23	SF					
Formaldehyde, <37%	c	23	SF					
Formic Acid, <30%	a	23	SF					
Formic Acid, 30-70%	c	23	SF					
Formic Acid, >70%	d	23	SF					
Gasoline	d	23	SF					
				5	24	1.0	-23.00	WS
				5	24	7.0	-24.00	WS
				5	24	28.0	-24.00	WS
Glycerol	b	23	SF					
Heptane	d	23	SF					
Hexane	d	23	SF					
Hydrochloric Acid, >70%				5	24	1.0	1.90	WS
				5	24	7.0	0.50	WS
				5	24	28.0	2.00	WS
Hydrochloric Acid, <30%	a	23	SF					
				5	24	1.0	-0.10	WS
				5	24	7.0	-0.10	WS
				5	24	28.0	-0.20	WS
Hydrofluoric Acid				5	23	761.0	18.10	33
				5	23	761.0	0.90	33
				5	23	761.0	14.30	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Hydrofluoric Acid, 30-70%	d	23	SF					
Hydrogen Peroxide, <30%	a	23	SF					
Hydrogen Sulfide	a	23	SF					
Isooctane	d	23	SF					
JP-4, Jet Fuel				5	24	1.0	-20.80	WS
				5	24	7.0	-20.00	WS
				5	24	28.0	-20.20	WS
Kerosene				5	24	1.0	-17.80	WS
				5	24	7.0	-17.70	WS
				5	24	28.0	-18.80	WS
Lactic Acid, <30%	a	23	SF					
Lactic Acid, 30-70%	c	23	SF					
Lactic Acid, >70%	c	23	SF					
Lead-Low Lead Gasoline Washwater				3	23	1340.0	6.00	33
				5	23	786.0	-1.50	33
				5	23	786.0	7.40	33
				5	23	786.0	-5.20	33
				8	23	1340.0	7.00	33
Magnesium Chloride	a	23	SF					
Mercuric Chloride	a	23	SF					
Mercury	a	23	SF					
Methanol, <30%				1	23	0.0	< 0.01	2
				5	24	1.0	-0.10	WS
				5	24	7.0	-0.10	WS
				5	24	28.0	-0.20	WS
Methanol, 30-70%	c	23	SF					
				5	24	1.0	-0.10	WS
				5	24	7.0	0.20	WS
				5	24	28.0	0.50	WS
Methanol, >70%	d	23	SF					
				5	24	1.0	-13.40	WS
				5	24	7.0	-20.60	WS
				5	24	28.0	-24.00	WS
Methylene Chloride	d	23	SF					
Methyl Ethyl Ketone	d	23	SF					
Mild Acids	a	23	14					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Municipal Solid Waste				2	23	243.0	2.40	33
				2	23	578.0	4.40	33
				2	23	928.0	3.87	33
				3	23	365.0	18.00	33
				3	23	1703.0	21.00	33
				3	23	1703.0	18.00	33
				3	23	1703.0	-3.00	33
				3	23	1308.0	40.00	33
				3	23	1308.0	41.00	33
				3	23	1703.0	3.00	33
				3	23	395.0	-10.00	33
				3	23	395.0	-5.00	33
				3	23	395.0	37.00	33
				3	23	395.0	-10.00	33
				5	23	365.0	6.72	33
				5	23	365.0	5.00	33
				5	23	365.0	4.64	33
				5	23	365.0	3.29	33
				5	23	365.0	0.75	33
				7	23	365.0	-9.00	33
				7	23	1703.0	6.00	33
				7	23	1703.0	-8.00	33
				7	23	1703.0	-6.00	33
				7	23	1308.0	-8.00	33
				7	23	1308.0	5.00	33
				7	23	1703.0	< 0.01	33
				7	23	395.0	-1.00	33
				7	23	395.0	5.00	33
				7	23	395.0	9.00	33
				7	23	395.0	4.00	33
				9	23	365.0	-12.00	33
				9	23	1705.0	-6.00	33
				9	23	1703.0	3.00	33
				9	23	1703.0	5.00	33
				9	23	1308.0	-3.00	33
				9	23	1308.0	-4.00	33
				9	23	1703.0	17.00	33
				9	23	395.0	-2.00	33
				9	23	395.0	-2.00	33
				9	23	395.0	-7.00	33
				9	23	395.0	-3.00	33
				10	23	365.0	-21.00	33
				10	23	1703.0	-8.00	33
				10	23	243.0	-13.00	33
				10	23	243.0	-20.00	33
				10	23	243.0	-11.00	33
				10	23	243.0	-9.00	33
				10	23	243.0	-8.00	33
				10	23	243.0	-21.00	33
				10	23	243.0	-4.00	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Municipal Solid Waste				10	23	578.0	-15.00	33
				10	23	578.0	-16.00	33
				10	23	578.0	-6.00	33
				10	23	578.0	-9.00	33
				10	23	578.0	5.00	33
				10	23	578.0	-12.00	33
				10	23	578.0	-5.00	33
				10	23	943.0	-2.00	33
				10	23	943.0	-6.00	33
				10	23	943.0	12.00	33
				10	23	943.0	4.00	33
				10	23	943.0	17.00	33
				10	23	943.0	1.00	33
				10	23	943.0	5.00	33
				10	23	1703.0	-7.00	33
				10	23	1703.0	3.00	33
				10	23	1308.0	-10.00	33
				10	23	1308.0	-13.00	33
				10	23	1703.0	7.00	33
				10	23	395.0	18.00	33
				10	23	395.0	5.00	33
				10	23	395.0	-13.00	33
				10	23	395.0	17.00	33
Nickel Chloride	a	23	SF					
Nitric Acid				5	23	751.0	22.10	33
				5	23	751.0	-6.10	33
				5	23	751.0	28.20	33
Nitric Acid, <30%	c	23	SF	5	24	1.0	0.20	WS
				5	24	7.0	0.60	WS
				5	24	28.0	1.90	WS
Nitric Acid, 30-70%	c	23	SF					
Nitric Acid, >70%				5	24	1.0	-3.40	WS
				5	24	7.0	-13.10	WS
				5	24	28.0	-16.10	WS
Nitrobenzene	d	23	SF					
Oil Refinery Sludge	a	23	31					
Oily-Aromatic Oil	d	23	14	5	23	761.0	18.50	33
				5	23	761.0	28.90	33
				5	23	761.0	14.10	33
Oily-Oil Pond 104				5	23	752.0	-10.40	33
				5	23	752.0	-0.50	33
				5	23	752.0	-9.80	33

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

Chemical	RATINGS Rating	 Deg C	 Reference	CHEMICAL RESISTANCE DATA Test	 Deg C	 Days	 Test Value (Exponent)	 Reference
Oily-Weed Oil				5	23	809.0	15.30	33
				5	23	809.0	24.70	33
				5	23	809.0	25.20	33
Oleic Acid	d	23	SF					
Oxalic Acid	a	23	SF					
Oxidizing Acids	d	23	14					
Pesticide - Weed Killer				3	23	1260.0	-7.00	33
				5	23	807.0	5.10	33
				5	23	807.0	1.00	33
				5	23	807.0	1.60	33
				8	23	1260.0	44.00	33
Petroleum Oil - No Aromatics	d	23	14					
Phenol	d	23	SF					
Phenol, <30%				5	24	1.0	-6.20	WS
				5	24	7.0	-14.70	WS
				5	24	28.0	-16.40	WS
Phenol, >70%				5	24	1.0	> 1000.00	WS
Phosphoric Acid, <30%	a	23	SF					
Phosphoric Acid, 30-70%	a	23	SF					
Potassium Chlorate	a	23	SF					
Potassium Chloride	a	23	SF					
Potassium Dichromate	a	23	SF					
Potassium Nitrate	a	23	SF					
Potassium Permanganate, <30%	b	23	SF					
Potassium Persulfate	a	23	SF					
Potassium Sulfate	a	23	SF					
Propane	d	23	SF					
Pyridine	d	23	SF					
Rubber and Plastic Waste	a	23	31					
Salt Solutions	a	23	14					
Sodium Bicarbonate	a	23	SF					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Sodium Bisulfite	a	23	SF					
Sodium Carbonate	b	23	SF					
Sodium Chlorate	a	23	SF					
Sodium Chloride	a	23	SF					
Sodium Hydroxide, <30%				5	24	1.0	-0.30	WS
				5	24	7.0	-0.80	WS
				5	24	28.0	-3.00	WS
Sodium Hydroxide, >70%	a	23	SF					
Sodium Hypochlorite, <30%	a	23	SF					
Sodium Nitrate	a	23	SF					
Sodium Sulfate	a	23	SF					
Sodium Sulfide	a	23	SF					
Stearic Acid	a	23	SF					
Sulfur Dioxide, <30%	a	23	SF					
Sulfuric Acid, <30%	a	23	SF	5	24	1.0	-0.40	WS
				5	24	7.0	-0.20	WS
				5	24	28.0	-0.10	WS
Sulfuric Acid, 30-70%	b	23	SF					
Sulfuric Acid, >70%	d	23	SF					
L-Tartaric Acid	a	23	SF					
Tetrachloroethylene	d	23	SF	5	24	1.0	> 1000.00	WS
Tetrahydrofuran	d	23	SF					
Thiophenol	d	23	SF					
Toluene	d	23	SF	5	24	1.0	> 1000.00	WS
Toluene, <30%				1	23	0.0	0.33	2
				1	23	0.0	0.71	2
				1	23	0.0	0.29	2
				1	23	0.0	0.17	2
Toxic Pesticide Formulations	a	23	31					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Toxic Pharmaceutical Waste	a	23	31					
Tributyl Phosphate				3	23	523.0	-11.00	33
				7	23	523.0	-69.00	33
				8	23	523.0	-72.00	33
				9	23	523.0	-33.00	33
Trichloroethylene	d	23	SF					
Urea	d	23	SF					
Water	a	23	SF					
	a	23	14					
				1	23	0.0	0.18	12
				1	23	0.0	0.12	12
				1	23	0.0	0.08	12
				1	23	0.0	0.08	12
				2	23	1935.0	-5.90	29
				2	23	3285.0	-5.50	29
				2	23	1569.0	-5.90	29
				2	23	1569.0	-5.90	29
				2	23	2920.0	-6.90	29
				2	23	2920.0	-9.80	29
				2	23	730.0	-9.10	29
				2	23	1460.0	-8.90	29
				2	23	3285.0	-12.50	29
				2	23	5110.0	-14.30	29
				3	23	1935.0	-42.60	29
				3	23	3285.0	-49.00	29
				3	23	1569.0	-52.20	29
				3	23	1825.0	-50.00	29
				3	23	2920.0	-52.60	29
				3	23	2920.0	-65.10	29
				3	23	730.0	-28.40	29
				3	23	1460.0	-21.80	29
				3	23	3285.0	-36.90	29
				3	23	5110.0	-35.00	29
				5	24	1.0	-0.10	WS
				5	24	7.0	-0.20	WS
				5	24	28.0	-0.20	WS
				5	23	365.0	1.85	33
				5	23	365.0	1.85	33
				5	23	365.0	2.10	33
				5	23	365.0	1.85	33
				5	23	365.0	0.60	33
				7	23	1935.0	-18.30	29
				7	23	3285.0	19.80	29
				7	23	1569.0	-12.20	29
				7	23	1825.0	-4.00	29
				7	23	2920.0	2.10	29

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Water				7	23	2920.0	-3.60	29
				7	23	730.0	14.30	29
				7	23	1460.0	17.30	29
				7	23	3285.0	18.20	29
				7	23	5110.0	10.30	29
				8	23	1935.0	42.00	29
				8	23	3285.0	107.30	29
				8	23	1569.0	56.20	29
				8	23	1825.0	70.70	29
				8	23	2920.0	79.90	29
				8	23	2920.0	87.50	29
				8	23	730.3	21.50	29
				8	23	1460.0	27.50	29
				8	23	3285.0	65.20	29
				8	23	5110.0	40.70	29
Xylene	d	23	SF					
Xylene, <30%				1	23	0.0	0.21	2
				1	23	0.0	0.06	2
				1	23	0.0	0.18	2
				1	23	0.0	0.08	2
Zinc Chloride	a	23	SF					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: POLYVINYL CHLORIDE-CHLORINATED POLYETHYLENE BLEND

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Jeg C	Days	Test Value (Exponent)	Reference
Toluene, <30%				1	23	0.0	0.21	2
Xylene, <30%				1	23	0.0	0.10	2

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: SOIL ASPHALT

	RATINGS			CHEMICAL RESISTANCE DATA					
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value	(Exponent)	Reference
Acidic Steel Pickling Waste	d	23	31						
Caustic Petroleum Sludge	bc	23	31						
Electroplating Sludge	d	23	31						
Oil Refinery Sludge	d	23	31						
Rubber and Plastic Waste	a	23	31						
Simulated Landfill				11	23	365.0	1.30	(-8)	33
				11	23	365.0	2.80	(-8)	33
				11	23	1703.0	8.60	(-8)	33
Toxic Pesticide Formulations	bc	23	31						
Toxic Pharmaceutical Waste	bc	23	31						

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: SOIL CEMENT

	RATINGS			CHEMICAL RESISTANCE DATA					
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value	(Exponent)	Reference
Acidic Steel Pickling Waste	d	23	31						
Caustic Petroleum Sludge	bc	23	31						
Electroplating Sludge	d	23	31						
Oil Refinery Sludge	a	23	31						
Rubber and Plastic Waste	a	23	31						
Simulated Landfill				11	23	365.0	1.50	(-8)	33
				11	23	1703.0	1.20	(-5)	33
				11	23	1703.0	4.30	(-7)	33
Toxic Pesticide Formulations	a	23	31						
Toxic Pharmaceutical Waste	a	23	31						

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: XR-5

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Acetaldehyde	a	23	SE					
Acetic Acid, <30%	bc	23	SE					
Adipic Acid	a	23	SE					
Aluminum Chloride	a	23	SE					
Aluminum Fluoride	a	23	SE					
Aluminum Potassium Sulfate	a	23	SE					
Aluminum Sulfate	a	23	SE					
Ammonia	a	23	SE					
Ammonium Chloride	a	23	SE					
Ammonium Hydroxide, <30%	a	23	SE					
Ammonium Hydroxide, 30-70%	a	23	SE					
Ammonium Hydroxide, >70%	a	23	SE					
Ammonium Nitrate	a	23	SE					
Ammonium Phosphate	a	23	SE					
Ammonium Sulfate	a	23	SE					
Amyl Acetate	bc	23	SE					
Aniline	a	23	SE					
Antimony Trichloride	a	23	SE					
Barium Chloride	a	23	SE					
Barium Hydroxide	a	23	SE					
Barium Sulfate	a	23	SE					
Barium Sulfide	a	23	SE					
Barium Carbonate	a	23	SE					
Benzoic Acid	bc	23	SE					
Boric Acid	a	23	SE					
Boric Acid, <30%	a	23	SE					
Butane	a	23	SE					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: XR-5

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
1-Butanol	a	23	SE					
Calcium Bisulfite	a	23	SE					
Calcium Carbonate	a	23	SE					
Calcium Chloride	a	23	SE					
Calcium Hydroxide	a	23	SE					
Calcium Hypochlorite	a	23	SE					
Calcium Nitrate	a	23	SE					
Calcium Sulfate	a	23	SE					
Chlorine	a	23	SE					
Chromic Acid, <30%	a	23	SE					
Chromic Acid, 30-70%	a	23	SE					
Citric Acid	a	23	SE					
Cupric Chloride	a	23	SE					
Cupric Nitrate	a	23	SE					
Cupric Sulfate	a	23	SE					
Ethane	a	23	SE					
Ethanol	a	23	SE					
Ethanol, 30-70%	a	23	SE					
Ethanol, >70%	a	23	SE					
Ethylene Glycol	a	23	SE					
Ferric Chloride	a	23	SE					
Ferrous Sulfate	a	23	SE					
Fluoboric Acid	a	23	SE					
Fluosilicic Acid	a	23	SE					
Fluosilicic Acid, 30-70%	a	23	SE					
Formic Acid, <30%	a	23	SE					
Gasoline	bc	23	SE					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: XR-5

Chemical	RATINGS			CHEMICAL RESISTANCE DATA				
	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Glucose	a	23	SE					
Glycerol	a	23	SE					
Hexane	a	23	SE					
Hydrazine	bc	23	SE					
Hydrochloric Acid, <30%	a	23	SE					
Hydrocloric Acid, 30-70%	a	23	SE					
Hydrofluoric Acid, 30-70%	a	23	SE					
Isobutyl Alcohol	a	23	SE					
JP-4, Jet Fuel	a	23	SE					
Kerosene	a	23	SE					
Lactic Acid, <30%	a	23	SE					
Lactic Acid, 30-70%	a	23	SE					
Lead Acetate	a	23	SE					
Magnesium Chloride	a	23	SE					
Magnesium Sulphate	a	23	SE					
Methane	a	23	SE					
Methanol	a	23	SE					
Mineral Spirits	a	23	SE					
Nickel Sulfate	a	23	SE					
Nitric Acid, <30%	bc	23	SE					
Phosphoric Acid, <30%	a	23	SE					
Potassium Bicarbonate	a	23	SE					
Potassium Bisulfate	a	23	SE					
Potassium Bisulfide	a	23	SE					
Potassium Bromate	a	23	SE					
Potassium Bromide	a	23	SE					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: XR-5

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Potassium Carbonate	a	23	SE					
Potassium Chlorate	a	23	SE					
Potassium Chloride	a	23	SE					
Potassium Chromate	a	23	SE					
Potassium Cyanide	a	23	SE					
Potassium Dichromate	a	23	SE					
Potassium Fluoride	a	23	SE					
Potassium Hydroxide	a	23	SE					
Potassium Hydroxide, <30%	a	23	SE					
Potassium Nitrate	a	23	SE					
Potassium Perchlorate	a	23	SE					
Sodium Benzoate	a	23	SE					
Sodium Bicarbonate	a	23	SE					
Sodium Biphosphate	a	23	SE					
Sodium Bisulfite	a	23	SE					
Sodium Borate	a	23	SE					
Sodium Bromide	a	23	SE					
Sodium Carbonate	a	23	SE					
Sodium Chlorate	a	23	SE					
Sodium Chloride	a	23	SE					
Sodium Hydroxide, 30-70%	a	23	SE					
Sodium Nitrate	a	23	SE					
Stearic Acid	a	23	SE					
Sulfuric Acid, <30%	a	23	SE					
Sulfuric Acid, 30-70%	a	23	SE					
Tannic Acid	a	23	SE					

Summary of Vendors' Ratings and Chemical Resistance Data

Liner Material: XR-5

	RATINGS			CHEMICAL RESISTANCE DATA				
Chemical	Rating	Deg C	Reference	Test	Deg C	Days	Test Value (Exponent)	Reference
Toluene	d	23	SE					
Turpentine	a	23	SE					
Urea	a	23	SE					
Water	a	23	SE					
Zinc Chloride	a	23	SE					
Zinc Nitrate	a	23	SE					
Zinc Sulfate	a	23	SE					